This paper is the last of three parts. The previous two parts were

Layer Problem

The simple models of shelf circulation components discussed so far were based on the coastal constraint assumolon and longshore uniformity. This is clearly restrictive: how far from shore the coastal constraint is valid is itself one of the important questions in shelf dynamics. A longshore sea-level gradient constant in space and time is evidently not a realistic assumption over larger pieces of the coastline. The focus of much recent work on shelf dynamics has been on determining the mechanism that allows longshore sea-level gradients to exist along open shelves, and the distribution of such gradients. The excitement of finding answers to such questions is still fresh for those of us involved in the exercise.

The rate at which the frictional coastal boundary layer

the mechanism of longshore pressure gradient generation by such local influences on a shelf region as longshore or crossshore wind stress distributed in an arbitrary way. Figures 1

grows (related to the effective horizontal diffusivity for sealevel perturbations) is proportional to the bottom resistance coefficient. In typical cases, a disturbance comes to occupy the entire shelf width (order 100 km) in a longshore distance of order 2000 km, which is comparable to the scale of weather systems or to continental dimensions. Much closer to the source of the disturbance (which may be simply a change of coast orientation). its effects remain confined to an innershelf boundary layer.



TRANSACTIONS, AMERICAN GEOPHYSICAL UNION

Editor: A. F. Spilhaus, Jr.; **Associate Editors:** Claude J. Allegre, Peter M. Bell, Kevin C. Burke, Kristina Katsaros, Gerard Lachapelle, Christopher T. Russell, Richard A. Smith, Sean C. Solomon, Carl Kissinger; News Writer: Barbara T. Shore; Editor's Assistant: Sandra R. Marks; Eos Production Staff: Patricia Bangert, Marga-

Eos, Transactions, American Geophysical Union (ISSN 0096-3941) 1960 weekly by the American Geophysical Union from 2000 Florida Avenue, N.W., Washington, D. C. 20009. Subscription availble on request. This issue \$5.00. Second-class postage paid at Mashington, D. C., and at additional mailing offices.

Copyright 1981 by the American Geophysical Union, Material published in the issue may be photocopied by individual scientists for research or deseroom use. Permission is also granted to use short quotes and transfer on use. twies and figures and tables for publication in scientific books and Amals. For permission for any other uses, contact AGU Pubications Office, 2000 Florida Avenue, N.W., Washington, D. C.

inlegs expressly stated.

fon. These cloud patterns, imaged from space by a Defense Meteotological Satellite, were produced by a mature mid-latitude cyone with a well-developed typhoon located near the southern end of the occluded front. The thermal infrared band image, in which he brightest areas are higher (colder) cloud tops and the gray areas are lower cloude, was taken over the eastern Pacific Ocean, ahour productions and taken over the eastern Pacific Ocean, ahour productions are also be or the contract of about 2500 km off the California coast, in 1975. This image is oriented need. ented north (top)-south (bottom), with the nearest northwest land, mass being the Aleutian Islands. The southernmost portion of the hage is near the equator. (Photograph and information courtesy of James 1987) of James Barnes and Alan Buffey, Environmental Research & (schnology, Inc., Concord, Mase.)

Circulation in the Coastal Ocean, Part 3

G. T. Csanady

Woods Hole Oceanographic Institution Woods Hole, Massachusetts

oublished in Eos January 13 and February 3.

Shelf Circulation as a Boundary

In a simple approach, it is reasonable to neglect the smallscale variations of shelf topography or of forcing in the longshore direction and to focus on such physical influences as maior changes in coastline orientation or wind stress varia-tions on the scale of weather systems. It is then still realistic to regard the coastal zone of interest as a narrow boundary region of a larger-scale circulation pattern. An appropriately simplified equation governing coastal sea levels now takes on the form of the heat conduction (or diffusion) equation, according to which any sea-level perturbation spreads out in the offshore direction, proceeding in a cyclonic direction alongshore. The theoretical model thus predicts the formation of an inner-shelf boundary layer which thickens in one specific longshore direction only, and that is in the direction of long-wave propagation.

The boundary layer model allows considerable insight into

The Weekly Newspaper of Geophysics

tet W. Conelley, Eric Garrison, James Hebblethwalte, Dae Sung Kim, Michael Schwartz.

Officers of the Union

J. Tuzo Wilson, President; James A. Van Allen, President-Elect; Hasila H. Meredith, General Secretary; Carl Kisslinger, Foreign Secretary; A. F. Spilhaus, Jr., Executive Director; Waldo E. Smith, Exec-

erilsing that meets AGU standards is accepted. Contact Elleen 0. Simms, advertising coordinator, 202-462-6903.

least expressed in this publication are those of the authors only and do not reflect official positions of the American Geophysical Union

Cover. This photo presents an interesting meteorological ques-

-010-:075 -050 220 188 157 126 94 -94 -126 -157 -188 -220 -251 -283 -314

Fig. 1. Sea-level distribution over idealized shelf with sloping bottom due to sinusoidally varying longshore wind. Stress is maximum positive (lowerd positive y) at center, ky=0, maximum negative at $ky=\pm\pi$. Longshore pressure gradient largely opposes the wind stress, but the pressure field decays with a typical offshore scale of 10-30 km. (From Csanady [1978].)

and 2 Illustrate the effect of a sinusoidally varying longshore wind on a long, straight shelf of constant slope, with the deep ocean supposed 'inert.' The first of these illustrations shows that a varying longshore wind sets up a coastally trapped steady pressure field akin to a topographic wave. If the longshore wavelength of the forcing is 1000 km, a typical value of the bottom resistance coefficient results in a trapping width of 50 km, i.e., trapping in a moderately narrow nearshore band. The dynamical role of the peculiar pressure field is elucidated somewhat by the transport streamline pattern of Figure 2. This figure shows the transition between the region where the coastal constraint is valid, and the longshore force balance is between wind stress, bottom stress, and longshore pressure gradient, and an 'outer-shelf' region where the total transport is only what flows onshore or offshore in a surface Ekman layer, so that most of the water column is quiescent.

Figure 1 shows that a specific distribution of surface levels is required to bring about the required balance of forces and that this is associated with a peculiar distribution of interior velocities over the inner shelf. Certainly physical intuition would not lead one to expect such a distribution. Of particular practical importance is the model prediction that the crossshore transport can be of significant magnitude as close to shore as 10 km, depending on topography, forcing, etc. The inner-shelf longshore current transports varying amounts of fluid, accepting the inflow from a surface Ekman layer further offshore, where the longshore wind stress drives it shoreward, and supplying the outflow, where the longshore stress is oppositely directed.

In a qualitative application of this model to realistic coastline geometry, one may think of longshore variations in forcing as being due to changes of coastline orientation. The calculated results suggest that the flow accommodates itself to such changes within an inner-shelf boundary layer, with the outer shelf not being affected. The open circulation cells associated with the flow adjustment should have considerable practical Importance as a mass exchange mechanism.

More complex wind fields lead to more complex solutions. Whatever the details, however, the parabolic nature of the governing equation and the effective horizontal diffusivity related to bottom friction govern the character of the solutions. Different driving forces may be thought of as driving different components of shelf circulation that are simply additive.

The effects of variable cross-shore wind stress show some interesting effects not revealed by the previous illustrations (Figures 3 and 4). The sea-level distribution is characterized by something like wind setup, showing a drop in levels near the maximum offshore wind and a rise near the onshore wind maximum. However, surface-level gradients are only significant within a coastally trapped band, which should have a typical width in practice of 10-30 km. Outside this band, the cross-shore wind stress is balanced by Ekman drift, as in the deep ocean. However, the Ekman drift in this case is not constant but rather has convergent and divergent regions. Over a sloping shelf, this leads to massive onshore flow (outside the region where setup is important) where the surface layer is divergent, offshore flow where it is convergent.

A potentially important forcing effect on the shelf circulation is the pressure field impressed by the deep ocean. In the boundary layer model, this appears as a boundary condition at the outer edge. A longshore pressure gradient impressed at the edge of the shelf affects the entire shelf much as the free-atream pressure gradient affects a laboratory boundary layer, on the reasonable supposition that the longshore scale of such a gradient is comparable to oceanic dimensions. Such an 'impressed' pressure gradient is thus more or less constant with distance from shore and leads to effects as discussed earlier in connection with the parallel flow shelf circu-

lation model (Figure 6, part 2; Eos, February 3).

The effects of variable freshwater inflow are also easily treated with the aid of the boundary layer model. Freshwater inflow is concentrated in major rivers, and even if each of these becomes effectively distributed over a few hundred miles of coastline, there are important variations in the rate of inflow between, say, the northerly and southerly part of continents. Such variations are responsible for longshore density and, hence, pressure gradients, which may be significant producers of shelf circulation. For example, if the density changes by 1 part in 1000 over a longshore distance of 1000 km, over a water column 100 m deep, a longshore sea-level slope of 10⁻⁷ results (1 cm in 100 km), which is of the same order as longshore gradients that are due to other causes. A slope of this magnitude should drive massive longshore flow, according to the boundary layer model.

EOS, vol. 62, no. 8, February 24, 1981 73

Over the Mid-Atlantic Bight, the observational evidence suggests that no significant trapped cells affect the mean flow beyond the 30-m isobath or so. The key driving force, the longshore pressure gradient, is then very likely a deepwater effect, impressed upon the shelf by offshore oceanic gyres. At the edge of the shelf this longshore gradient is certainly as large as it is closer to shore.

The magnitude of the longshore pressure gradient is not constant in time, however, but is subject to clear seasonaland perhaps longer-term—variation. An interesting aside is that at the time of the Argo Merchant oil spill off Nantucket Island (December 1976), the usual southwestward driving longshore pressure gradient was fortuitously absent, and the water column was moving eastward under strong northwest winds, taking the oil spill eastward and out to sea.

One factor contributing to longshore sea-fevel gradient, at least in the northern portion of the Mid-Atlantic Bight, appears to be freshwater influx further north, notably in the Gulf of Maine and the Gulf of St. Lawrence. According to the boundary layer model, longshore variations of freshwater influx over such a long range (order 1000 km) affect more or less the entire width of the shelf, which would make their effects difficult to distinguish from deepwater gyre effects. The magnitude of the longshore pressure gradient that is due to observed density variations may be estimated to be 1 cm in 100 km (10⁻⁷) during the spring runoff period only, and a much lower slope at other times of the year. This effect may partly explain the seasonal variation of the longshore gradient.

Over the inner shelf, evidence for the theory that trapped cells affect the long-term mean circulation pattern comes from nearshore studies in different locations. These show different magnitudes of the longshore pressure gradient. Near the 'apex' of New York Bight, such local variations are particularly clear. The details of these trapped cells have not been elucidated so far, at least not in connection with a long-term mean circulation pattern. On the other hand, there is clear evidence which shows that trapped pressure fields accomoany storms.

Storm Currents over Atlantic-Type Shelves

From an economical point of view, the most important problem in applied oceanography is the prediction of storm surges, which from time to time cause tremendous damage along coastlines adjacent to broad continental shelves such as the North Sea, the U.S. Gulf Coast, and the East Coast. Consequently, numerical models are well developed for the prediction of coastal sea levels associated with hurricanes and extratropical storms. These models have been calibrated empirically and today constitute a useful practical tool. They do not, however, give a particularly realistic description of storm-driven currents, at least not without considerable further

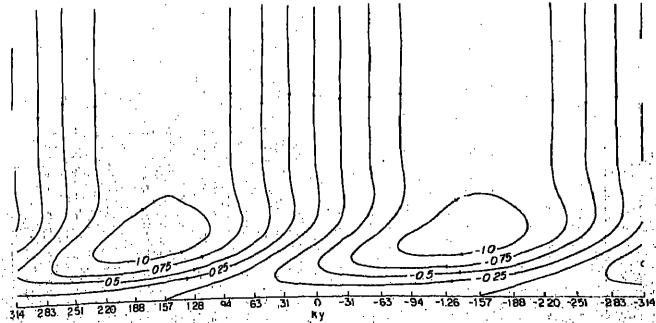


Fig. 2. Transport-streamline pattern corresponding to pressure field shown in Figure 1. Transport is in phase with the wind at the shore, but lar from shore it becomes cross-shore Ekman transport associated with longshore wind atress.



9

-

V

FOS, TRANSACTIONS, AMERICAN GEOPHYSICAL UNION

VOL. 62, NO. 7, PAGES 65-72

FEBRUARY 17, 1981

Oceanography

egan (grafil hagh) in denembry da grafik agasterning. Ni katag denembra yag in da grafik agasterningsan ya i Ni katag da magamili ni da grafik agasterningsan ya in CINCIPAT A TO TANAMATE, OTTO PROPERTY OF THE STREET OF THE CAPTIBLE CONTINUES AND STREET, OF THE CAPTIBLE STREET OF THE STREET O Tage Patterns furing early february, 1979, Each nearder had a tertically exterent, seemed water-like subsurface structure. The Eulegien velocity and temperature atymatures produced to the meanfers at the 15th level over the 31Cm tucketh reflect this mestress, at a particular instru-tent, the in-chase intersees in temperature and in stress colority associated with an approxi-ing searder crest coursed fixing a longer time intercal than its the more tapis decreases in ing searcer creat coloured foring a longer size interest than list the more rapid devemben in these quantitates following the treat's pessage. This sleet fluctured from about 720s seat's to rest 100 on seat's, while the coloureream conjugate that can seried appreciately 150 on seat's to rest 100 on seat's, while the coloureream conjugate that the series appreciate them. For a particular nearlier, the master in the fitting below the colour test and without the seat of the american in the line in a matter typical of the american was retired in a matter of a measure for a seat of the seat less than the last of the american seat of the se and the first and a state of the continuity of the farthered in the first of the first and the first the for the deal of the rel pen, and when sepa-cate level the mind held of the triff Stream by the leader. The presence of the could water between the Stream and the differents at the suf-face who had to the religion of water from deep within to be a the rain lineam. Feath in the rise cation of within any remain in the the maintain, the lead of within a contacting occurred bett it is warder result. In the leading contact the trivials near where a wash filment joined a wanter reader. The remains now have been inter-ated presents of our study orea, and then "availabled" he the define in process off Charleston. Street has calculations for the reader of Charles by indicate that magning water as being eventuals man example these,

wenter greeth weekin the fift fin ar no breedi-

Antrey further Seastenan. Peans 160102

beanfer every sardniested to miss

History (A) 127

H. Faul Froitag (CGA) Facific Hivine Environmental Lateratory, 371 18th Avenus Vr. Seattle, kashington (9103) and D. Hitpern

A historyappine mirror of 286 CTD stations was rade in Pay 1977 in the region between 17%; (i.e., near Ean Francisco) and 45%; (i.e., Cape Blanco in Southon Congon). Constail upwelling was rest intense south of Cape Mandocine. At 300 m an intense turperature and salinity frontal cone occurred between 15%; and 39%. The domain-in-light topographies 07900 db and 300/900 db contained regions of highs and less with length scales of 100/150 km. North of Cape Mandocino the sam saling sater identified as the poleward California Undercurrent was not observed and the transport integrated above 590 db was southourd.

(Chiffenia Current and Undercurrent, oddles, fronts). A733 Enteries, bays, and fords
MICROWIS ENDINATES MEASURDERY OF TIPALLY
INACES SALINITY CHANGES OFF THE GEORGIA COAST
B. Kendall (NSA Langley Research Center, M/S 400
Mempton, VA 21855 and J. Blanton
A quasi-symptic survey of tidelly induced
salinity changes off the Cergia coast was perfurmed using a 1-hand microwave radiometer onboard
a NSA alteraft. Salinity maps were obtained for
ebb and flood conditions in order to define the
salinity distributions near rivers and sounds and
major chaiges that occur from abt flow to flood
flow. The Savannan River plane declinated the
salinity ragine and extended our from the Savannah
River mouth shout 12 km during ebb tidal condition. The plane marged into a band of toy
salinity water satending along the Georgia-South
Caralins Coast which was produced by the many
river mountes of frembuster entering the coestal waters, the changes in salinity observed off-waters. The changes in salinity observed off-shore of the river pluss area were consistent with exclusive of the changes that would occur water a typical tidal watersion perponditular to the observed gradient. (Salinity, Lides, countai waters, remote sensing) Tiver sources of freshwater entering the casted J. Hoophys. Res., Green, Paper 100171

4710 Distributions and enter russes Bileographic Germanions of Montgen Galifornia IU-190 (Mr. 1977

J. Selphys. Pes., Green, Paper 100007

4/65 Surface waves, tides, and sea level INE EXPENDID YELOCITY POTENTIAL VS STOKES MAYE PEPRESENTATION W. J. Lambrakos (Erson Production Research Company, Mouston, Texas)

The velocity potential for finite surface water maves is expressed in terms of a double fourier series expension in the wave number and frequency. This form of the velocity potential paralis, nonlinear interactions between wave harmonics and can describe periodic waves that deform with propagation (EXP waves) as well as 510 ms. I provide the part of the emergy in each harmonic component is transferred from the lower to the higher frequencies and vice versa, the outward affect of the nonlinear interactions is the modulation and demodulation of the waves as they propagate. The changes in wave shape affect the wave it remaities accordingly, and examples are presented to illustrate this point. Also, on the basis of examples the EXP volution for Stokes waves is shown superior in accuracy to the well knows Stokes' y solution but in close agreement with other higher order Stokes wave procedures.

J. Gamphys. Exe., Greem, Paper LCOLIP

J. Gasphys. Res., Green, Paper LC0119

A7:1 Surface vaves, tides, and see level
HSPICOTAL PARIFICE VELOCITIES II LEG MAYED
L. A. Swedsen (Inst. Hydrodyn, and Hydraulic
Engra., Tach. Univ. Denmark, Building 115,
LL-27:0 Lyngby, Denmark) and C. Stamb
A general expression is derived for the horiroatal particle velocities in long waves. The
derivation is based on a polynomial expansion in
the vertical coordinates which results in an expression for a in terms of the surface elevation
of and its derivatives. The result is walled for
high waves but is in the preliminary form not
directly applicable. It is shown, however, that
for waves of relatively small amplitude to depth
ratio the result corresponds to the well-known
onoidal wave theory. The horizontal velocities
predicted by that theory is then critically examined and it is shown that there are conflicting
properties, which imply that no choidal theory
can be satisfactory for waves nigher than 32-bol
of the depth of water. Instead a simple formula
based on a parabolic truncation of the above zenticaed polynocial in a is derived for the velocity unfer the creat of arbitrary high waves. The
results are companed both with experients and
with attean function theory and particularly the
latter gives remarkably good agreement even for
the highest waves. (Very high surface waves,
rholds! theory corparison with resaurements).
J. Geophys. Res., Green. Paper 80C1756

4790 Instruments and techniques OBSERVATIONS OF WATER PLOW WITH HIGH RESOLUTION

OBSERVATIONS OF MATER PLON WITH HIGH RESOLUTION DOPPLER SONAR

R. Lheraithe (University of Mismi, Resemblie! School of Marine and Atmospheric Science, 4600 Richembeter Causaway, Mismi, Florida 33149)

A coherent pulse Deppier somer with a few conclosions range remodution provides effective modification of allow water velocity with excellent rangulation. The experiments presented in the paper were conducted with a money remediator. remaintion. The experiments presented in the repart war conducted with a some transducer resting on the floor of a waterway influenced by idal effects with the transducer producing a bean tilted from the hottzontal. All the remuits are shown in the form of Doppler Spectra Lorpesad of radial valicity estimates separated by a few more above from the form of Doppler Spectra Lorpesad of radial valicity estimates separated by a few more from the form of the ster surface in derived from the data. Continuous monitaring for those profiles shows considerable detail in the evolution of the abbyfiles characteristics of the flow during tidal cycles. (founder soner, mererus, estuaries flow).

4790 Instruments and techniques BEASAT SAR CROSS-SECTION MODULATION BY BURPACE BEASAT SAN CROSS-SECTION MODELATION BY SURPACE WINDS: OGSARYATIONS
T.V. Thompson (Plannbary Science Institute, Science Applications, Inc., Passedens, CA 91101), D.L. Neissamm, and P.I. Gonzalas
Sassat raday observations of the Gulf of Almska by the Synthetic Aperture Radar (SAR) and that by the Synthetic Aperture Radar (SAR) and that L-hand buckscatter is undulated by wind speed and possibly by wind direction. In particular, L-hand buckscatter is undulated by wind speed and possibly by wind direction. In particular, L-hand suckscatter is undulated by wind speed and direction by the following;

of a Undulated to wind speed and direction by the following;

of a Undulated Tradar erose-maching, B is wind appead, e is wind-spader angle, a is 0.3 +
0.1, and b is 0.05 + 0.03. This relationship suggests that a combination of Sassat SAR and Scatterometer data may yield high respolution maps of surface winds.

of surface winds. Gaophys. Res. Latt., Paper SOL1774

Fig. 3. Sea-level distribution over idealized sloping shelf due to sinusoidally variable cross-shore wind stross. Wind stress is maximum offshore at $ky \Rightarrow 0$, maximum onshore at $ky = \pm \pi$. Setup opposes the wind over the inner shelf, while over outer shelf, sea-level distributton is in geostrophic balance with subsurface flow (see next illustration). (From Csanady [1980].)

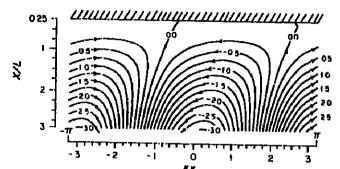


Fig. 4. Transport streamlines corresponding to pressure field in Figure 3. Over outer shelf there is massive onshore flow in region where wind stress curl is cyclonic (ky = n/2), offshore flow where anticyclonic (ky · · · #/2).

development and calibration. In any event, the predictions of the models are almost as complex as the observational evidence, and it is desirable to understand the contribution of storms to the circulation problem in terms of simpler con-

Strong winds acting over shallow water rapidly establish frictional equilibrium flow, so that this aspect of the circulation problem is best approached by way of steady state models. The classical models of hurricane surge are of this kind [Freeman et al., 1957; Bretschneider, 1966]. Although wavelike resurgences' are sometimes important, the bulk of the coastal sea level rise attributable to storms can be explained as a sleady state, coastally trapped pressure field. Associated with this pressure field are intense longshore currents which are generated by storms, presumably giving rise to farge particle displacements. Bolcourt and Hacker [1976] point out, for example, that most of the mean southwestward drift off Chesapeake Bay in the Mid-Allantic Bight is generated by a few nor easterlies, as vividly illustrated in their paper through the use of progressive vector diagrams of observed currents.

@

C?

in a steady state model, coastal sea level rise is due to two effects: setup in response to onshore wind and geostrophic adjustment to balance the Coriolls force of longshore currents. From the point of view of the circulation problem, coastal sea levels are incidental, but of course longshore gradients of sea level that form part of a trapped pressure field under a storm affect the intensity of longshore currents. Of great practical importance for mass exchange are the crossshore motions in the open circulation cells associated with trapped pressure fields. The simple boundary layer models discussed above have shown that the longshore scale (wavelength') of the forcing by wind is of key importance in determining the circulation pattern. Storms of small spatial scale may create a particularly intense circulation cell on the

Extratropical storms have typical scales of 1000 km and more. Hurricanes are 3-10 times smaller in diameter, but their maximum winds are much higher. Maximum wind stress In a hurricane reaches values of 30 Pa and more.

Clear evidence for a trapped pressure field associated with hurricanes has already been presented by Redfield and Miller [1957] (see Figure 5 here). The maximum longshore sealevel gradient shown in this illustration is about 8×10^{-6} , which, in water 50 m deep, would alone drive a longshore current with a velocity of about 1.5 m/s. Moreover, this gradient drives the water in the same direction as the longshore stress ahead of the eye of the hurricane just prior to landfall and so increases the maximum longshore current above what the wind stress alone wou

Intuitively, the sea-level distribution shown in Figure 5 is not difficult to understand as an effect of the cross-shore

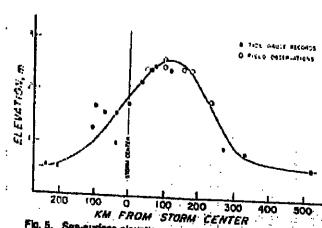


Fig. 5. Sea-surface elevations accompany Atlantic coast hurri-canes, from Redfield and Miller [1957]. Maximum elevation occurs well to the right of the storm center, looking along the path of the storm as it crosses onto land.

component of the wind that causes a setup to one side of the eve. a set-down to the other side. A similar effect is revealed by the boundary-layer shelf model acted upon by variable cross-shore wind, the sea-level distribution for which is shown in Figure 3. Figure 4 shows the corresponding streamline pattern. The equivalent of the eye of a storm is located in both figures to the right of the center, where the cyclonic curl of the wind stress causes substantial onshore transport. The coastally trapped pressure field is instrumental in deflecting the onshore flow in a longshore direction and causes strong longshore currents without any longshore wind. In an actual storm, of course, the important effects of longshore winds are superimposed on this pattern.

The longshore component of the wind in a storm generates a pressure field that generally opposes the wind stress, and hence the longshore current close to the coast (cf. Figure 1). Summing the effects of cross-shore and longshore winds causes partial cancellation of the longshore gradient in the case when the storm center is located offshore. With the storm center over land, the pressure gradients add up, both opposing the direct driving force of the wind. The relative strength of the longshore gradients produced depends on the spatial extent of the slorm. For a hurricane (small diameter), the cross-shore wind effect dominates, as empirical data show in Figure 5 above. The longshore elevation gradient that is due to longshore wind is relatively more important for an extratropical storm of large diameter.

In the Mid-Atlantic Bighl, extratropical storms that have their centers well to the south of the Bight produce vigorous southwestward flow, while storms with their centers well to the north, although they apply intense local wind stress directed to the northeast, produce little net flow because their effect is balanced mainly by an opposing sea-level gradient. The phenomenon may be explained if one supposes that in such larger storms the cross-shore and the longshore wind effects are roughly equal as far as longshore pressure gradient generation is concerned. With the storm center offshore, nearly complete cancellation may then be expected, while a particularly strong gradient should oppose the longshore wind stress when the storm center is well to the north.

Mean Circulation of a Stratified Fluid

In discussing the development of wind-driven transient flow in a stratified fluid, it was noted that the Isopycnals rise or sink in a relatively narrow nearshore band that is scaled by the internal radius of deformation, and they undergo large vertical excursions, even under modest wind stress impulses. If a steady state flow pattern is eventually approached in such a case, the tendency to vertical isopycnal displacement within the same nearshore band should persist and must be counteracted by dissipative processes, mixing, and internal friction. A steady state pattern of upwelling or downwelling circulation then comes into existence in which the vertical advection of temperature and salinity is balanced by mixing across (and along) isopycnals. Modeling of the flow and pressure fields associated with similar phenomena is greatly hampered by our limited understanding of dissipative processes in a stratified fluid. In a recent review article, Allen [1980] concludes that similar model studies are all more or less unrealistic for this reason. At the same time, however, these model studies clearly show that a boundary layer of a scale of the internal radius of deformation may well accomplish mass balance closure in somewhat the same way as the frictional boundary layer over a slope (Figure 2 or 4), i.e., accepting Ekman transport over some portions of the coast and supplying it over other portions.

Given the absence of a realistic parameterization scheme for nearshore dissipative processes in a stratified fluid, the simplest step is to ignore them and construct a steady circulation model without friction and mixing. In the absence of mixing and inction, the fluid conserves potential vorticity, and a flow pattern may be calculated without difficulty by using linearized theory. This pattern is illustrated in Figure 6.

In this illustration, the total transport equals the Ekman drift over most of the basin, so that below the Ekman layer the fluid is quiescent. A coastal boundary layer, typically 5-10 km wide, accepts the Ekman drift along the right-hand shore and transports it around the ends of the basin to the coastal boundary layer along the left-hand shore, which supplies the fluid for the interior Ekman transport. The surface remains flat, except within the coastal boundary layers. Along the shores parallel to the wind, a pressure gradient opposes the wind in the upper layer, but the lower layer is entirely quiescent. Correspondingly, the pycnocline has a strong tilt in the longshore direction as we ll as cross-shore. At the coast there is exact balance between wind stress and pressure

gradient force in the upper layers. One should not take loo seriously the details of this simple linear theory flow pattern. The main point is that the adjustment of the isopycnals to a steady flow pattern may allow a transition from a quiescent interior (except for surface Ekman drift) to an active coastal boundary layer over a distance range of 5-10 km. In particular, a longshore pycnocline tilt may develop, generating a pressure gradient in opposition to the wind in the top layer alone and confined to a coastal band. Dissipative processes would presumably spread out the trapped density field implied by this model to a scale larger than the internal radius of deformation, but the basic character of the pycnocline tilts might well remain as predicted by the model. Along continental slopes, in particular, a considerable range of depth is available for the development of longshore isopycnal till.

The monthly average summer circulation in Lake Ontario is sometimes found to exhibit a coastal jet pattern similar to that shown in Figure 6, at least along the south shore. The analysis of IFYGL (International Field Year on the Great Lakes) data for July and August showed that along this shore eastward and westward jets in warm water were associated with a thermocline tilt both cross-shore, for geostrophic equilibrium, and longshore. The longshore thermocline tilt corre-

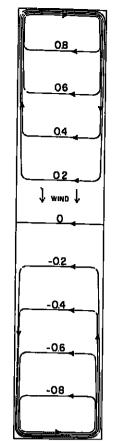


Fig. 6. Steady transport streamline pattern in two-layer fluid conlained in a 5:1 rectangular container acted upon by steady wind Surface-level distribution is flat in the center but is characterized by strong gradients in a coastal boundary layer (scale width, the internal radius of deformation) both cross-shore, for geostrophic balance, and longshore, opposing the wind. (From Csanady and Scott

sponded to a pressure gradient not quite sufficient to balance the wind stress. The north shore pattern was, however, drastically different, and there were also other complexities which, for the present, remain unexplained. Part of the difficulty is probably that long-term fixed-point mean currents do not reflect particle velocities and are physically more or less mean-

Many observations of currents, densities, etc., are available during the summer (upwelling) season off the Oregon shelf, and from these a seasonal mean circulation pattern may be pieced together [Huyer et al., 1979; Mooers et al.,

The longshore components of mean velocities are southward at the surface, strong above the inclined density front, and northward below the surface in depths of 100 m or more. The mean velocity of the coastal let is of the order of 0.3 m/s. The northward flow below is referred to as the poleward undercurrent, and this appears to be trapped over the upper slope in depths less than 500 m.

Cross-shore velocities present a more complex picture and have been the subject of considerable controversy. Some of this was no doubt caused by a confusion of Eulerian and Lagrangian means, an acute problem in an upwelling zone where some fixed point current meters sample widely different water masses in the course of upwelling-downwelling events. What is not in doubt is that over most of the water column the cross-shore velocity is directed shoreward most of the time and has an amplitude of about 2 cm/s. Across the 100-m isobath, this implies onshore transport of about 2 m²/s, or about 3 times more than the offshore Ekman transport at the surface associated with the mean wind stress. There is also some offshore Ekman transport in the bottom boundary layer of the poleward undercurrent, but it is very unlikely that this is sufficient to maintain two-dimensional mass balance by transporting away most of the onshore flow that arrives throughout the water column. Various studies have also convincingly demonstrated that some of the water drawn from deeper levels is heated at the surface and sinks along isopycnals of the pycnocline when the latter intersects the free surface. This implies offshore motion along some isopycnals, but it is not clear whether the quantity is sufficient to affect the cross-shore mass balance significantly.

A long-term mean onshore velocity of about 2 cm/s, constant with depth, implies a longshore sea-level gradient of 2 × 10⁻⁷, driving nort iongsnore gradient (and magnitude may also be inferred from the density field of the North Pacific [Reid and Mantyle, 1976]. In the yearly ayerage, this gradient is confined to latitudes south of 38°N, but in the summer it extends to 44°N, and thus encompasses the Oregon shelf. The cross-shore sea-surface slope associated with the density field extends to about 100 km from the shore. i.e., it coincides with the poleward undercurrent. The longshore sea-level slope is associated with a corresponding pycnocline slope, more or less as in the simple model of Fig. ure 6. The longshore momentum balance of the poleward undercurrent is thus dominated by a northward driving pressure gradient that is balanced in the frictionless interior by onshore flow. Where the onshore flow runs into the continent tal slope, a northward current develops, with associated bo tom friction. The longshore isopycnal slope along the west coast of North America is apparently part of a larger-scale response of the North Pacific to wind stress. The undercurrent transports relatively warm and saline water northward

over a considerable range of latitude. In the surface layers, offshore wind-driven Ekman drift is compensated by onshore flow in a layer of about 30 m depth i.e., essentially above the main pycnocline. Onshore flow in the deeper layers turns seaward, partly in the bottom boundary layer below the undercurrent, but this circulation is confined only to the trapping width of the boundary current (~ 50 km), and in any case it is insufficient for two-dimensional

mass balance. The rest of the inflow is presumably accomodated in an intensified boundary current in a rather more complex situation than Figure 6 illustrates but nevertheless in the same general manner.

Conclusion

The later sections of this article have increasingly focused on long-term, larger-scale flow phenomena, which are at best partially understood. The mean circulation problem clearly requires a further study in all three environments discussed here, as well as in even more complex cases, such as semienclosed basins. To quote another conspicuous gap in knowledge, the summer circulation over the East Coast continental shelf shows complexities that, at present, appear completely puzzling, including a bottom-trapped cold band of water flowing along the outer shelf, the water supply for which seems to originate in the Gulf of Maine. On the other hand, we seem to possess a fair understanding of short-term transient flow events over the inner shelf.

incomplete as our present state of knowledge of coastal circulation may be, it clearly provides a much better basis for assessing the environmental impact of various human activities than was available a few years ago. Present policies and rules of the regulatory agencies do not reflect this, presumably because scientific understanding has not yet been translated into the engineering science of pollution modeling, at least not at the necessary level of sophistication, i.e., focusing on the probabilities of undesirable events rather than on such simplistic measures of nuisance or hazard as the 'mean concentration' of a pollutant, whichever way the mean is defined. It should be well within the realm of possibility to develop the more advanced poliution prediction models required and to distill from the science of coastal circulation the quantitative inputs necessary for these models.

This work has been supported by the Department of Energy under a contract entitled Coastal-Shelf Transport and Diffusion. A fuller, more quantitative version will be published in 1981 in Advances in Geophysics.

References

Allen, J. S., Models of wind-driven currents on the continental shelf, Annu. Rev. Fluid Mech., 12, 389-433, 1980.

Bolcourt, W. C., and P. W. Hacker, Circulation on the Atlantic conti-nental shelf of the United States, Cape May to Cape Hatteras, Mem. Soc. Roy. Sci. Liega, 5(X), 187-200, 1976.

Bretschneider, C. L., Engineering aspects of the hurricane surge, in Estuarine and Coastline Hydrodynamics, edited by A. T. Ippen, pp. 231-256, McGraw Hill, New York, 1966. Csanady, G. T., The arrested topographic wave, J. Phys. Ocean-

ogr., 8, 47-62, 1976. Csanady, G. T., Longshore pressure gradients caused by offshore wind. J. Geophys. Res., 85, 1076-1084, 1980. Csanady, G. T., and J. T. Scott, Baroclinic coastal jets in Lake On-

tarlo during IFYGL, J. Phys. Oceanogr., 4, 524-541, 1974. Freeman, J. C., L. Baer, G. H. Jung, The bathystrophic storm tide, J. Mar. Res., 16, 12-22, 1957.

Huyer, A., E. J. Sobey, and R. L. Smith, The spring transition in currents over the Oregon continental shelf, J. Geophys. Res., 84, 6995-7011, 1979.

Moders, C. N. K., C. A. Coillins, and R. L. Smith, The dynamic structure of the frontal zone in the coastal upwelling region off Oregon,

J. Phys. Oceanogr., 6, 3–21, 1976.
Redfield, A. D., and A. R. Miller, Water levels accompanying Atlantic Coast hurricanes, Meteorol. Monogr., 2(10), 1-23, 1957.

Reld, J. L., Jr., and A. W. Mantyla, The effects of the geostrophic flow upon coastal sea elevations in the northern Pacific Ocean, J. Geophys. Res., 81, 3100-3110, 1976.

Reflections From the Executive Office Building

Peter M. Bell Associate Editor, Eos

A. F. Spilhaus, Jr. Edilor, Eos

Four years ago, Frank Press came to Washington to take on what amounts to the position of chief scientist for the United States of America. He came to serve a new President as his personal science advisor and to be director of the Office of Science and Technology Policy in the Executive Office of the President. As a new administration takes over in Washington, Frank Press has returned to MIT for a brief respite before assuming, on July 1, 1981, the presidency of the National Academy of Sciences for a 6-year

When Frank Press arrived in Washington in early 1977, he was relatively unknown in political circles. He would have to become very well known to the President, to members of the House and Senate committees, to the Office of Management and Budget (OMB), to representatives from industry, and to all departments of the executive branch of government. Frank Press leaves office not only very well known but very well respected as an apolitical human who

served effectively among politicians. His own views of his time in Washington are provided in two recent articles in *Science* magazine (January 9 and 16, 1981). On his last day, in his third-floor office overlooking the north lawn of the White House, Frank Press took time out to describe to us a few of the high points of his last 4

years and to muse on the future for geophysics. in Washington, Frank Press played two distinctly different but intertwined roles. As the President's science advisor, Frank Press had to put his abilities and those of the scienlific community at the service of the President. In this era it is hard to envision a piece of legislation or a regulation that does not require scientific input. It is equally as hard to separate science from economic, regulatory, or defense issues. As director of the Office of Science and Technology Policy (OSTP), Press did not deal primarily with science or scientists but rather with issues that affected science and science policy and with individuals who handle these issues. The rapport he established with OMB contributed heavily to his success. Concepts in government, no matter



Frank Press has been a leader throughout his caer, in 1957, at age 33, he became director of the ismological Laboratory of the California Institute of echnology. He was elected to the National Academy of Sciences in 1958. In 1980 he was named Califorala scientist of the year, and in 1962 he was honored by Life magazine as one of the 100 most important: oung people in the United States. In 1965 he assumed the chairmanship of MIT's Department of Earth and Planetary Science, and he served as AGU president from 1974 to 1976. He has received humerous awards and medals for his scientific achieve

how noble or valid, become no more than bureaucratic paper if funding does not support them. A sympathetic President and an effective science advisor/OSTP director were behind the fact that science and technology funding fared very well during the past few years.

In addition to issues and concepts the implementation of scientific programs within the federal government and of programs that rely heavily on scientific input were Influenced by Press's advice on the selection of key personnel. His quickly established credibility made it automatic to turn to him, and he in turn consistently surveyed the scientific community for opinions and advice both on Issues and on personnel. He canvassed individuals and went to various scientific and technical organizations, including societies, for help. Press commented on the role of some of these organizations. Some were effective lobbying groups; others, such as the American Physical Society, prepared excellent analytical reports; and still others were like the AGU, with which he had essentially no formal interaction during his term in the White House. Although societies in the earth sciences have not prepared public policy studies, such as the well-known ones prepared by the American Physical Society and the Academy, he sees that there may be such a role in the future for AGU.

Extraordinarily high-level consideration is required by the far-reaching implications of so many issues that are closely related to science. Press commented on various space missions and about policy-related issues ranging from recombinant DNA to energy policy. Two programs of particular interest to geophysicists are synluels and ocean margin drilling (OMD). Press noted that the U.S. has sufficient energy resources available but not instantly so. To initiate either significant synfuel production or an ocean margin drilling program, the federal government must support and protect the undertakings. However, neither will function well unless it is ultimately in the hands of industry.

The federal government role is essential because, in the case for synfuel development, for example, an oil cartel could adjust and chop prices in ways that would cripple the inciplent industry. In the OMD case the payout is likely to be decades away, and the research could be put off. Industry requires a sharing of the cost if it is to do the work at an earlier stage and thus to bring in knowledge in order to clarify the country's future alternatives. The OMD program would be politically dead today if Frank Press had not been able to bring together government and industry.

The routes by which scientific and technical issues travel from conception to implementation in the government directly influence the outcome. At the highest levels, individuals' backgrounds, skills, and prejudices can become all important. Frank Press was fortunate. His old friend and colleague Harold Brown was secretary of defense, smoothing the way for an extraordinary collaboration in that key area. He was not without other scientific colleagues in high places: for example, AGU members Hans Mark, secretary of the Air Force; Robert Frosch, administrator of NASA; and William Menard, director of the U.S. Geological Survey. Press worked closely with OMB on the science asots of departmental budgets. He remarked that whenever the secretary of a department, for whatever reason, was behind an issue, the way was clear and everything flowed smoothly. But if for any reason the secretary was not positive, the issue was completely dead. Among the government agencies. Press singled out for special praise the U.S. Geological Survey under William Menard-a highly efficient and thoroughly professional scientific organization that Press feels has received less than the credit due it in the past several years.

in looking at where geophysics is headed in the next few years, Frank Press talked about a golden future, a future full of opportunities in science and opportunities for employment and new careers. He cited the new liaison between geology, geophysics, oceanography, and the planetary sciences and the overriding importance of these areas in dealing with the critical natural resource problems that the nation and the world face. New techniques and scientific discoveries will keep excitement in geophysics at a high pitch for many years. He mentioned specifically the new seismic reflection profiling, such as the COCORP program; hot water circulation in the ocean ridges; the Venus Orbiter Imaging Radar and the Galileo space missions; and high-pressure research as contributing to this excitement. As Press spoke, one sensed perhaps a bit of envy for the young sci entist who has before him such extraordinary opportunities to contribute.

In talking to Frank Press one forms a picture of an effec-

tive team with perhaps continually changing players, the President, department secretaries, and advisors, dealing with issues and broad policy matters-sometimes effectively and other times less effectively, but always with the national Interest foremost. Much of the work Frank Press undertook was effective because the President cared about science and engineering, and the President understood the Importance of considering the Input of scientists. Frank Press could communicate with the President: 'The President knows what I mean when I talk about the second derivative going to zero.' The effectiveness of Frank Press' service to the President and his role in strengthening science and engineering, two distinct areas both carried out so well, depended not only on a willingness of those in high places to listen but also on affirmative action. Many of the people who worked with Press during the last 4 years will remain on the White House stall. It is our hope that they will transmit to their new bosses, whether they be economists, lawyers, industrialists, or scientists, the importance of including scientific considerations, of seeking out scientific advice, and of keeping the scientific base on which this country grows healthy. Frank Press has established a fine foundation as the first full-term director of the Office of Science and Technology Policy. It remains to his successors to build upon it. We also expect that his successors will hear from him and that in his new role as president of the National Academy of Sciences, which is truly a role in which one represents science and scientific institutions, geophysicists will have cause to be very proud of one of

Water Resources Monograph 5

Groundwater Management: the use of

numerical models 1980

A State of the Art Review

Discussions on groundwater models and their applications in the management of water resource systems. Attention is focused on the kinds of models that have been developed and their specific and general role in management, the availability of the models and the information, data and technical expertise needed for their operation and use.

ISBN: 087590-306-1 Catalog No.: WM0500 Soft-cover

Barbara Andrews David Holtz 136 pp. . Illustrated List Price \$5.00

Scott Sebastian editors

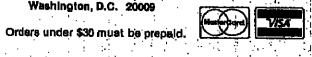
Yehude Bachmat

John Bredehoeft

AGU members are entitled to a 20% discount.

Order from:

American Geophysical Union 2000 Florida Avenue, N.W. Washington, D.C. 20009



Acid Precipitation

Copies of the draft National Acid Precipitation Assessment Plan are available for public comment from the interagency Task Force on Acid Precipitation. The plan, which outlines a 10-year national research program, is open for comment until April 3. It supersedes an earlier plan proposed by the former Acid Rain Coordinating Committee (ARCC).

The national assessment program aims to identify the sources, causes, and processes involved with what is commonly known as 'acid rain,' i.e., precipitation with a pH less than 5.7. However, the deposition of acidic substances in the atmosphere is not limited to rainy periods; dry deposition also occurs. Major processes for dry deposition are gravitational settling of coarse particles, impaction of particulate acrosols, and the absorption or adsorption of gases.

Sulfur and nitrogen exides, emitted from automobiles and coal- and oil-burning power plants, usually take the blame for causing the increased atmospheric acidity. This has prompted some to claim that acid rain is a local or regional problem. Preliminary measurements at remote islands in the Pacific and Indian oceans, however, indicate that acid rain may be a global phenomenon.

Acid deposition was tackled by the ARCC, which was established by President Carter's environmental message in August 1979. In September 1980, the committee issued draft copies of its 10-year plan. Two months before that draft was issued, the Acid Precipitation Act of 1980 was signed into law, creating the interagency Task Force on Acid Precipitation, composed of 12 federal departments and agencies. In November the new task force incorporated ARCC and, using the ARCC 10-year plan as a baseline, began drawing up a new plan on acid rain research.

The task force's draft is 'less strident and has a more balanced tone' than the ARCC preliminary plan, according to Chris Bernabo, executive secretary of the Interagency Task Force. The new draft also makes fewer assumptions and places 'greater emphasis on uncertainties' about acid deposition, he said. In addition, more attention is given to understanding the atmospheric processes involved in the transportation, transformation, and deposition of acidic materials within the atmosphere, noted Bernabo, who was also the AGU Congressional Science Fellow in 1978–1979.

Nine research tasks are the focus of the plan. Each has a lead agency, with funds budgeted expressly for research, and each has agencies that contribute to the work. NOAA leads two of the nine: The agency is charged with leading the research on analysis and assessment of natural resources of acid deposition and the research on atmospheric processes. The Environmental Protection Agency (EPA) leads research on aquatic Impacts of the acid deposition, control technology, and the assessments and policy analysis. The Department of Energy is stated as the lead agency to research man-made sources, while the Department of the Interior heads the work on the deposition monitoring of acid substances and on the effects on materials. Research on terrestrial impacts is assigned to the Department of Agriculture.

Copies of the draft can be obtained from Chris Bernabo, Executive Secretary Interagency Task Force on Acid Precipitation, Council on Environmental Quality, 722 Jackson Place, N.W., Washington, D.C. 20006. All comments on the draft plan should be directed to Bernabo.

The task force is cochaired by NOAA, the Agriculture Department, and EPA. Also participating are nine other federal departments and agencies: the Departments of Commerce, Energy, Interior, Health and Human Services, and State, the Council on Environmental Quality, NASA, the National Science Foundation, and the Tennessee Valley Authority.—BTS ©

H Gas: Captured at Last?

@

U

in the strange world of low-temperature physics, few more unusual phenomena have been discovered than monatomic hydrogen gas. According to a recent report (New Scientist, Jan. 1981, p. 204), hydrogen atoms do not tend to pair up to form molecules under special low-temperature cryogenic experimental conditions. The reasons for the existence of atomic hydrogen gas at ultra-low temperature, and for its implications, lie in an understa is almost pure quantum mechanical properties. Practical uses of atomic hydrogen will await more knowledge of its proporties, but right now, if available in sufficient abundance, atomic hydrogen could be used in maser clocks because it emits highly defined frequencies of microwave radialion at room temperature, and atomic hydrogen gas could be used as an energy conservative fuel, as it recombines to the diatomic molecule. For every recombination between two hydrogen atoms, 4.5 eV of energy are released, which calculates to be over 1 million waits of power per second for 10 grams of atomic hydrogen recombined. The large impulse relative to its light mass could be significant in applications of atomic hydrogen as a rocket fuel. Practical applications aside, the main interest in atomic hydrogen at this moment is in the insight into quantum mechanics that study of its properties may provide. Atomic hydrogen aloms 'abound throughout the universe,' even though not on Earth, and thus quantum effects in space, and the hydrogen-rich planets as well, may be elucidated by results of these studies.

Sitvera and Wairaven describe helium at low temperatures as almost ideal from a quantum standpoint, but not quite (New Scientist, U.S.). Monatomic helium remains only as liquid to temperatures as close to absolute zero as attainable. In the cryogenic range between 2.18 and 0 °K, Ilq.

uid hellum (hellum I) changes into the so-called superfuld state (hellum II).

Helium II is difficult to contain as it tends to creep up the walls of its container and dribble away. The superfluid flows without viscosity or damping and can pass through small holes and membranes that are impermeable to other liquids. The superfluid state is evidently the finite temperature ground state of zero momentum predicted theoretically by Einstein, and thus study of the properties of liquid helium that has 'condensed' into the superfluid state could offer a unique examination of quantum theory. Problem is, superfluid helium atoms interact strongly, and the interactions prevent analogy with theoretical quantum states. Modern theory cannot provide a description of a strongly interacting liquid such as helium. Monatomic hydrogen, however, could provide a better case for comparison with numerous theories.

The importance of the availability of atomic hydrogen gas in the laboratory is that the results of its study may allow a definitive experimental verification of the relation between the superfluid state and the state predicted by Einstein (known as Bose-Einstein condensation). Hydrogen is predicted to remain a gas, even at 0°K. Being a gas, its density can be reduced so that the interactions between atoms are weak enough to place its behavior within the precepts of modern theory.

Atomic hydrogen actually has been known for many years in the laboratory, but in a highly unstable form produced by the dissociation of molecular hydrogen in an electrical discharge. The new process of producing atomic hydrogen utilizes a magnetic field that draws the atoms like a bar magnet; those with the lowest energy state are drawn to the strongest portion of the field. The process feeds hydrogen atoms from an electrical discharge into a cryogenic cell placed with a superconducting magnet. The hydrogen gas can now be held in the cell for indefinite periods.

The experiments with atomic hydrogen are still in their intency. It has not been possible yet to produce a gas dense enough to have superfluid properties that are amenable for study. What is being attempted is to increase the density by a factor of 10. When that happens, the fruits of this breakthrough may be realized.—PMB S

Are There Options for Nuclear Waste?

The problems of storage of nuclear wastes are reaching crisis proportions. Although conceding that a measure of the crises has been caused by the enormous emotion of protesting green ecologists, (ISR, Interdisciplinary Science Reviews, 5(4), 1980), the bottom line is that nuclear wastes have been and continue to be dumped into the oceans and scattered in leaking and leakable containers on the surface. There is a fear among members of the nuclear engineering community that the U.S., under recent government restrictions, has placed itself in a compromising position on the development of nuclear power facilities. One area of concem is that of nuclear waste disposal. Other countries are subject to the same problems and fears. For example, in the Federal Republic of Germany the term 'Enstorgungszentrum' has been coined to describe the total process of reprocessing and disposal of spent nuclear fuel elements. The concern is that spent fuel continues to accumulate because restrictions and laws have affected efforts to resolve the problems of reprocessing and disposal. Right now the environment is subject to damage from the inadequate storage practices of the past. Geoscientists working on the problem of waste disposal await the answers to queslions about the projected quantity of waste to be disposed. The options to be explored depend on the volumes to be

Recently, an official of the Department of Energy estimated that the total amount of radioactive waste from nuclear power plants that exist now could fill only the area of a football field, stacked to a height of 10 feet. This appears to be an unexpectedly small volume of material, but not included in this estimate are the huge volumes of military wastes.

Furthermore, emotional protests aside, if the construction of nuclear power plants does increase markedly, the volume of wastes will be much larger. In any case, even the most extreme estimates suggest that the amounts of radioactive waste are manageable.

The necessary number of half-lives for which radioisotopes must be stored is on the order of a 'geologic time scale,' so the options for storage must necessarily involve indefinite time protection factors. One obvious option is to store the waste in space (Spacetlight, 22(182), 1980), where thousands of years of stability should be no problem. The safety factors involved in getting the wastes into space are in question, however, as are the costs. It is important to realize that the risks of handling nuclear power plant materials in conventional operations are very low, even by comparison with the risks of handling other materials (op. cit.). The conclusion, based on current wisdom, is that it will be safe to store the wastes on the surface or in the ground.

A preliminary step in storing nuclear wastes is known as reprocessing; this step is also banned in the U.S. at this time. Reprocessing is a concentration and separation technique to remove some isolopes (especially Pu²³⁸) for reuse and to separate high-level from low-level radioactive wastes. Although this step involves the risk of making nuclear materials that would present a potential danger if they fell into the wrong hands, it is thought by some to be a crucial step in disposal planning. One option in the storage scheme for all wastes is to incorporate them in a glass host or crystallize the waste into synthetic mineral structures ('SYNROC'). The purpose is to form a synthetic material

that has both high chemical resistance and favorable thermal and other physical properties. As with the other stages of spent-fuel reprocessing, continuing research on synthetic host materials is needed.

Considering the constraint that nuclear wastes must be stored and isolated safely for at least 1000 years, it would appear that the choices are few, but this is not necessarily true. Surface (or slightly subsurface) storage is a viable option. There are and will be many types of concentrated redioactive materials located on the earth's surface. It might be argued that they would be in the way of human progress and would be too accessible. Improved canisters of synthetic rock could be kept under control, however, and knowledge of their existence could be transmitted to fulure generations. Their very accessibility could be an important factor, not only in their safety but in their possible future reuse, when and if more economical isotope separation methods are developed. The difficulty lies with the 'human factors, particularly public acceptance of almost visible storage practices.

'in or under the surface' includes land, oceans, and ocean floors. The practice of allowing liquid radioactive wastes to flow directly into the sea would appear to be completely unacceptable at all levels. Containment, even in its present state of development, is so much safer. It may be possible to drop projectile-shaped containers into the ocean to penetrate the sediment. There are suggestions, currently under consideration, to place waste-filled containers in holes drilled through the ocean sediment into basalt. The environmental impact of all ocean storage schemes may be unacceptable, however. Perhaps the best alternative for underground storage known today may be in stable geologic formations such as salt domes, as was first tried in the U.S. in the 1950's.

The domes are known to persist stably for hundreds of millions of years and the salt seals out the intrusion of groundwater. Caverns excavated in salt domes last indefinitely, and the salt itself, being a good thermal conductor, is a favorable sink for radioactive heat. According to a recent report (ISR, interdisciplinary Science Reviews, loc. cit.) of tests done at the Asse abandoned salt mine in Germany, totally reliable techniques exist for the safe disposal of wastes of all levels of radioactivity.

It appears clear that, barring public outcry and government intervention, the path to safe storage of nuclear wastes is straightforward, and the best options are beneath the surface, either in salt mines or in the shafts of excavaled rock formations. Continuing research on reprocessing of wastes, including the incorporation of separated fractions in synthetic rock or glass; on the geology, geophysics, geochemistry, and hydrology of suitable sites; and on the storage containers will be needed to provide data as the storage builds.—PMB 38

NACOA Vacancles Filled

Six scientists were recently appointed to the President's National Advisory Committee on Oceans and Atmospheres (NACOA) as part of the committee's normal rotation, according to Steven Anastasion, executive director. Two of the six positions were reappointments.

The committee, consisting of 18 scientists not working in the government, advises the executive and legislative branches on federal programs dealing with the oceans and almosphere. Each member serves for 3 years; six positions become vacant each year as part of the rotation system.

The committee meets about every 6 weeks. Currently under consideration is an evaluation of the role the oceans play in waste-management strategies, Anastasion sald in addition, NACOA will examine national goals and objectives of research and management of the oceans and atmospheres.

Warren W. Washington, chairman of the IUGG Subcommittee for the international Association of Meleorology and Atmospheric Physics, was reappointed to a second term on NACOA. Also reappointed was Sharron Stewart, commissioner of the Texas Deep Water Port Authority.

The four new appointees are Burt Keenan, chairman of the board and chief executive officer of Offshore Logistics, Incorporated, in Louisiana; Jay Lanzillo, Industry representative of Chatham Seafood Corporation in Massachusetts; George Tapper, president of Tapper and Company in Florida; and Charles Warren, president of Charles Warren Associates in California. Warren was the first chairman of the Council on Environmental Quality under President Carter.—875 &

Saving For a Rainy Day

Critics of solar energy repeatedly point to the technology's ineffectiveness at night or during cloudy days. Proponents argue that storage systems can provide the necessary backup, but the critics counter that the development of storage systems will slow solar energy's growth and add to the already high cost per kilowatt. Now a National Research Council committee adds its voice to the chorus.

The Solar Panel of the Committee on Advanced Energy Storage Systems says that the need for storage systems will not delay solar energy development. Present growth for most applications can proceed in the short run as expected. Delays may occur, however, with 'stand alone' electric lty-generating systems, which are not connected to a utility network.

Because solar energy relies on the sun, certain regions of the United States that do not continuously attract sun worshippers could not depend on the technology as a con-

stant and sole energy source; nighttime energy demands also require some backup or storage system. Storage is now limited to facilities that use excess power in off-peak hours to pump water into reservoirs. That water is then released to turn hydroelectric turbines when demand for electricity is high. Geography limits this type of storage.

The Department of Energy's 'ongoing R&D programs on such technologies as underground pumped hydro, compressed air, and advanced batteries will, if successful, facilitate the market penetration of solar-derived electricity,' the committee says in a recent report. More utilities would then be able to install storage systems.

The committee recommends that storage R&D efforts be focused on long-term options that will be responsive to both the economic and technical requirements of high-solar-penetration energy systems. More knowledge is needed, in the committee's opinion, about the social factors—public preferences or perceptions—that could influence the acceptance of solar energy and storage systems.—BTS

Mountain Research

The newly incorporated International Mountain Society (iMS) will in May begin publication of an interdisciplinary scientific journal, *Mountain Research and Development*. The quarterly will be copublished with the United National University; additional support will come from UNESCO.

A primary objective of IMS is to 'help solve mountain land-use problems by developing a foundation of scientific and technical knowledge on which to base management decisions,' according to Jack D. Ives, president of the Boulder-based organization. 'The Society is strongly committed to the belief that a rational worldwide approach to mountain problems must involve a wide range of disciplines in the natural and human sciences, medicine, architecture, engineering, and technology,'

'Mountain,' as used by the new society, covers a lot of ground. They interpret the term to include uplands and steep slopes at lower elevations, as well as the peaks and rances.

IMS expects to prepare an inventory of institutions conducting research on mountain areas and a register of individuals possessing what the society judges as the professional, technical, and/or scientific skills applicable to mountain environments.

Officers of IMS include the president and two vice presidents: Cornellle Jest of France and Heinz Loffler of Austria. A council of scientists, engineers, architects, and administrators also guides the society.

For Information about membership and journal subscriptions, contact IMS, P.O. Box 3148, Boulder, Colorado 80307. 3

Geophysicists

Thomas M. Donahue, chairman of the department of atmospheric and oceanic sciences at the University of Michlgan, was awarded the Arctowski Medal by the National Academy of Sciences 'in recognition of his fundamental contributions to understanding the role of solar radiations in the physics and chemistry of the atmospheres and ionospheres of the Earth, Mars, and Venus.' The medal accompanies a \$5000 prize.



Doyle G. Frederick will serve as acting director of the U.S. Geological Survey until a new director is selected. He joined the USGS in 1973 and has served as associate director since February 1980. He has also been the associate chief of the survey's National Mapping Division.

Donald F. Gatz has been appointed head of the new atmospheric chemistry section of the Illinois State Water Survey. He is a member of the statistics faculty at the University of Illinois.

James P. Gibb has been appointed head of the new groundwater section of the illinois State Water Survey. He joined the Water Survey in 1966.

Gerald J. Wasserburg, at the California Institute of Technology's division of geology and planetary sciences, was awarded the Arthur L. Day Prize and Lectureship by the National Academy of Sciences in recognition of his work with isotopes, studying geophysical problems of the solar system.

The following reports changes in the executive staff of the American Meteorological Society (AMS) and reports awards presented at the annual awards banquet in San Diego.

Flichard E. Hallgren, director of the National Weather Service, National Oceanic and Atmospheric Administration, has been chosen president-elect of AMS. He will assume office in 1982.

Robert G. Fleagle, atmospheric sciences professor at the University of Washington in Seattle, is the incoming AMS president. He succeeds Robert M. White, president of the University Corporation for Atmospheric Research.

The five councilors elected to 3-year terms of office are: James Philip Bruce, assistant deputy minister of the Environmental Management Service, Fisheries and Environment Canada; Edward M. Caristead, chief of the Forecast Division, National Meteorological Center of the National Weather Service; David S. Johnson, assistant administrator for satellites, NOAA; Norman J. Rosenberg, professor and director of the Center for Agricultural Meteorology and Climatology, Institute of Agriculture and Natural Resources, University of Nebraska at Lincoln; and Stanley L. Rosenthal, director of the National Hurricane Research Laboratory, NOAA.

Roscoe R. Braham. Jr., was awarded the Carl-Gustaf Rossby Research Medal, the highest honor accorded by AMS. The professor in the Department of Geophysical Sciences at the University of Chicago was selected for his notable contributions in research and effective leadership in the study of complex convective systems."

Thomas H. Vonder Haar, professor and head of the Department of Atmospheric Sciences at Colorado State University, and Charles D. Keeling, oceanography professor at the Scripps Institution of Oceanography, shared the Second Half Century Award.

Jerome Namias, an oceanographer at Scripps, received the Sverdrup Gold Medal 'for his studies of the ocean's role in climatic variability. His long-term dedication to large-scale, air-sea interaction and inspiring leadership has laid the basis for present progress.'

Stanley A. Changnon, Jr., chief of the illinois State Water Survey, received the Cleveland Abbe Award for his work on the impacts of weather and climate on humanity.

Charles L. Hosler, Jr., received the Charles Franklin Brook Award for outstanding services to AMS. He is a meteorology professor and dean of the College of Earth and Mineral Sciences at the Pennsylvania State University.

Julian P. McCreary, Jr., an assistant professor of physical oceanography at Nova University's Ocean Sciences Center in Dania, Florida, received the Editor's Award for his reviews of manuscripts submitted to the Journal of Physical Oceanography.

William M. Frank was chosen as the recipient of the Banner I. Millier Award for contributions to the science of hurricane and tropical weather forecasting. He is an assistant professor in the Department of Environmental Sciences at the University of Virginia.

New Publications

New Listings

liems listed in New Publications can be ordered directly from the publisher; they are not available through AGU.

Sedimentation in Oblique-Silp Mobile Zones, Spec. Publ. 4 Int. Assoc. Sedimentol., P. F. Ballance, H. G. Reading (Eds.), Blackwell Scientific Publications, Boston, Mass., vi + 265 pp., 1980.

Soil Chemistry, H. L. Bohn, B. L. McNeal, G. A. O'Connor.
 John Wiley, New York, xiv + 329 pp., 1979, \$19 95.
 Stratigraphic Lexicon of Libya, Bull. 13, S. Banerjee, Industrial Research Centre, Socialist People's Libyan Arab Jamahiriyah, Tripoli, xviii + 300 pp., 1980

Thunderstorms, Develop. Atmos. Sci. 12, C. Magono, Elsevier, New York, x + 261 pp., 1980.
The Upper Cretaceous-Tertiary Formations of Northern

Libya: A Synthesis, Bull. 12, M. F. Megerisi, V. D. Mamgain, Industrial Research Centre, Socialist People's Libyan Arab Jamahiriyah, Tripoli, x + 85 pp., 1980. U.S. Earthquake Observatories: Recommendations for a

New National Network, National Academy Press, Washington, D.C., xvii + 122 pp., 1980

Volcanoes, R. Decker and B. Decker, W. H. Freeman, San

Francisco, Calif., ix + 244 pp., 1981.

Water Resource Systems Planning and Analysis, D. P.

Loucks, J. R. Stedinger, D. A. Haith, Prentice-Hall, Englewood Cliffs, xiv + 559 pp., 1981, \$29.95.

Western Water Resources, Coming Problems and the Policy Alternatives, Federal Reserve Bank of Kansas City, Westview, Boulder, Colo., 1980, \$25.00.

Classified

EOS offers classified space for Positions Available, Positions Wanted, and Services, Supplies, Courses, and Announcements. There are no discounts or commissions on classified ads. Any type that is not publisher a choice is charged for at display rates. EOS is published weekly on Tuesday. Ads must be acceived in writing on Monday 1 week prior to the date of the teams provided.

data of the issue required.

Replies to ada with box numbers should be addressed to: Box....., American Geophysical Union, 2000 Florida Avenue, N.W., Washington, D.C. 20009.

POSITIONS WANTED Rates per line 1-5 limes—\$1.00, 6-11 limes—\$0.75, 12-26 limes—\$0.55

POSITIONS AVAILABLE
Rates per line
1~5 times—\$2.00, 6-11 times—\$1.60,
12-26 times—\$1.40

SERVICES, SUPPLIES, COURSES, AND ANNOUNCEMENTS Rates per line 1-5 times—\$2,50, 6-11 times—\$1.95 12-26 times—\$1.75

POSITIONS AVAILABLE

Lunar Curatorial Laboratory: Manager.

Northrop Services, inc. has operated and maintained the NASA Lunar Curatorial Laboratory at the Johnson Space Center, Houston, Texas since its inception. We are now searching for a manager candidate with a Ph.D. in geology or geochemistry, evidence of administrative skills and a record of meteorial investigations. Position involves the supervision of 38 technical, scientific and ciercal employees. Interested persons should send resume. Including publications and references to W. B. Kurz, Manager of Personnel Services, Northrop Services, NSI is an equal opportunity/affirmative action employer.

Acadia University. The Department of Geology, Acadia University, is seeking a head, beginning July 1, 1981. Preference will be given to applicants with experience and research interests in petroleum geology and related fields and/or energy resources. Rank and salary will be appropriate to qualifications. The successful candidate will assume leadership of an established, vigorous and growing department with five faculty members, and over 100 B.Sc. and M.Sc. candidates. Responsibilities include teaching at undergraduate and graduate levels, and academic planning and development in the specialty area. A letter of application together with a curriculum

A letter of application together with a curriculum vitae and names of three referees should be sent by March 15, 1981 to Dr. Earnest E. Zinck, Dean of Science, Acadia University, Woffville, N.S., BoP 1X0.

Battelle, Pacific Northwest Laboratories. Applications are invited for a postdoctoral position in geophysics with emphasis on middle or upper atmospheric research at the Battelle Observatory in Richland, Washington. Silpend will be
\$18,000 initially; the position offers the possibility of
a permanent research position at the end of the
positioctral appointment. Address inquiries to
R. A. Stokes, Battelle Observatory, Battelle, Pacific
Northwest Leboratories, P.O. Box 999, Richland,
WA 99352.

Geophysicist. The Geology Department at the University of Southwestern Louisians in Lafayette, Louisians in Vites applications for an anticipated research/teaching opening in geophysics. Responsibilities will include one held time in selemic investigation of geopreseured-geothermal reservoirs of South Louisians and one-half time leaching geophysics and supervising graduate students. The successful applicant will be familiar with exploration selemic data acquisition, processing, and interpretation. The Ph.D. or Masters with experience, is required. Salary range is \$23,000 to \$35,000 per 12 month.

The position is expected to be filled in the Spring of

The position is expectable thereafter.

1981 or as soon as possible thereafter.

To apply please direct a require, three letters of recommendation, and any other pertinent materials to: Dr. Gary L. Kinsland, Geology Department, University of Southwestern Louisians, Lalayette, LA 70504

Sediment Transport/Geological Oceanography, North Carolina State University. A tenure irack position is available in the Department of Marine, Earth and Atmospheric Sciences at the level of assistant or associate professor. Applicants should have a thorough understanding of sediment transport, and a general background in geological oceanography. A Ph.D. is required. The candidate will be expected to strengthen the graduate teaching and research programs. The applicant's research interests can be theoretical, experimental, or observational, but must involve quantitative examination of marine sediment transport. Applicants should forward a resume, including a list of courses teken/laught, and the names of at least three references to Dr. Charles A Nittrouer, Cheirman, Search Committee, P.O. Box 5068, NC State University, Rateigh, NC, 27850. Application materials should be sent by March Caroline State University is an equal occore.

North Carolina State University is an equal opporunity/affirmative action employer.

Faculty Appointment/Octorado State University. The Department of Earth Resources, Colorado State University invites applications for a tenure track appointment with emphasis on active research experience in remote sensing, and an interest in teaching graduate and undergraduate students beginning September 1981. The candidate is expected to have a Ph.D. degrae in geology, watershed sciences or in a related field and is expected to develop and maintain a vigorous research program with special emphasis on the application of state-of-the-ait remote sensing techniques to the investigation of natural resource phenomena. The candidate is expected to teach undergraduate and graduate courses in the application of remote sensing to natural resources.

rai resources.
Rank and salary are open and dependent on experience and qualifications of the applicant.
Applicants are invited to submit curriculum vitae, three letters of reference and a letter describing research and teaching interests to Dr. H. S. Boyne, Department of Earth Resources, Colorado State University, Fort Colline, Colorado 80523/(303) 491-

:298. Deadline for receipt of applications is April 15, 1981. CSU is an EOE/AA. E.O. Office; 314 Student Serv. Structural Geologist/University of California, Santa Barbara. Applications are invited for a tenure track appointment in structural geology to be filled during 1981-1982, subject to availability of funds. Rank dependent upon qualifications and experience, but preference will be given to the assistant professor level. Successful candidates must have Ph.D. degree and strong desire and commitment to teach and direct MA, Ph.D., and undergraduate students in both structural and field geology. He/she will be expected to develop a strong research program and obtain outside funding for its support. Additional duties may include teaching physical geology and

aummer field geology.

Please send resume and evidence of teaching and research proficiency, by March 31, 1981, and arrange for early submission of four letters of recommendation to Dr. Arthur G. Sylvester, Chairman, Department of Geological Solences, University of California, Santa Barbara, CA 93108, (805) 961-3158.

The University of California is an affirmative ection/equal opportunity amployer.

Physical Oceanographer/ Geophysical Fluid Dynamicist

Areté Associates, a growing research firm, located in Southern California, engaged in theoretical and empirical physical ocean-ography, is offering permanent; fuit-time positions. Candidates require Ph.D. (or equivalent experience) in physical ocean-ography or geophysical fluid dynamics. Salaries are competitive and negotiable, based on qualifications. Areté offers a fringe benefit package of superior quality. Qualified candidates should send résumé, salary history, and list of professional references to:

Personnel Administrator Areté Associates P.O. Box 350 Encino, CA 91316

An equal opportunity employer M/F.

Physical Oceanographer. The Department of Marine Science and Engineering, North Carolina State University, has an immediate opening for a locioral research associate. Research will be directed loward equatonal circulation dynamics, in-cluding seasonal and higher-frequency variability. Participation in fieldwork will be required. Qualifice tions include a Ph D or equivalent in physical oceanography or geophysical fluid dynamics and oxe ence in the analysis of oceanographic time series. The initial appointment will be for 2 years, with a pos sible continuation subject to availability of funds. Sa ary is competitive and negotiable, based upon qualifications. Applicants should send the names of three references, a resume, and publication list to Robert H Weisberg, Department of Manne Science and Engineering, P.O. Box 5923, NC State University, Raleigh, NC 27650.

Faculty Position: University of Jowa, The Department of Physics and Astronomy anticipales one or two openings for tenure track faculty in August 1981 Research specialties for which substantial resources are available are magnetospheric and auroral physics and space and laboratory plas ma physics, both theoretical and experimental. Other specialities of interest are astronomy, astrophysics, elementary particle physics, atomic physics, condensed matter, and low energy nuclear physics The positions involve undergraduate and graduate teaching, guidance of research students, and personal research interested persons should sond a resume, a statement of resourch interests, and the names of three professional references to Search Committee, Department of Physics and Astronomy, University of Iowa, Iowa City,

The University of lowe is an equal opportunity af-

Meteorologist/Remote Sensing. Immediale opening for meleorologist interested in investigating retrieval and modeling of sea surface temporatures and other ocean meteorological parameters from microwave data. Carulidate must have post graduare training in melecirology and interest in remote sensing. Salary negotiable depending on experience. Send resumes to flodger Smith, Manager of Staffing, Systems and Applied Sciences Corpora-tion, 6811 Kemiworth Avenue, fliverdale, MD 20840. An equal opportunity employer

Vincent C. Kelley and Leon T. Silver

Graduate Fellowships

THE UNIVERSITY OF NEW MEXICO

The Department of Geology of the University of New Mexico Invites ap-

plications for the Vincent C. Kelley and Leon T. Silver Graduate Fellowships. The followships will be awarded on the basis of the

scholastic record and academic promise of graduate applicants. Each

fellowship will provide for a generous living stipend of \$1,000/month for 9 to 12 months, and up to \$2,000/year for travel and research expenses.

The Caswell Silver Foundation will pay all tuition and university fees.

The awards are made on an annual basis, but may be renewed for up to

three years as long as the student maintains excellent academic stand-

ing and shows evidence of significant progress in research. Preference

will be given to, but is not restricted to, applicants for the Ph.D. program.

The deadine for applications is April 1, 1981 for the Fall semester of 1981.

The Caswell Silver

THE UNIVERSITY OF NEW MEXICO

y of the University of New Mexico is pleased

Seismologist. The Tennessee Earthquake in-formation Center (TEIC) is seaking applications for the position of seismologist beginning July 1981. The position will also be a joint lenure track appointment in the Department of Geology. Primary duties, however, are with TEIC; teaching will be or a time-available basis, not to exceed one course

The Ph D. is required and experience with lefemety networks is required and expension with received applicant will be expected to assume co-PI responsibilities on the Memphis and Southern Appalachian seismic natworks, as well as actively pursue externally funded research projects digital data fon are other aspects of the job.

The TEIC is a research organization of Memphis State University and the State of Tennesses, 12month safary (\$25,000 and above) depends on background and experience. Position is 1/4 state supported, 1/4 (summor) from external sources. Application deadling: 15 April 1981. Send resume, publications list, short statement of research in-terests, and names and addresses of four relaters

Arch Johnston, Director Tennessee Earthquake Information Center Memphis State University Memphis, Tennessee 38152 Memphis State University is an equal opportunimalive action employer.

Postdoctoral Research Associate. Oceanography Department of the Naval Postgraduate School seeks recent graduate to study the hydrodynamics, through numerical ocean mod of the physical oceanographic processes selleof the physical oceanographic processes active in the vicinity of the arctic ico edge off Alaşkri. Problem areas include the offects of the complex balliymetry on the circulation and frontal formation, the dynamics associated with interleaving of water masses at the ace edge, and the machanisms involved in ice retreat Research will be performed in the centext of an obsorvational program which has required data and

developed insights over the course of several years Position is available March 1981 and is renewable annually, Solary depends upon qualifications Sond rosume and the names and addresses of three references to Faculty Search Committee, Dept. of Ocean-ography, Naval Postgraduale School, Monterey, CA 93940

Equal opportunity/affirmative action employer.

Von Braun Post-Dectoral Fellowship in Space Physics/University of Alabams in 1981 in a tenure track assistant professorship w reduced leaching load during the first two years. Re-search specialty in astrophysics, planetary science or solar terrestrial physics. Research support available from UAH, NASA and Redstone Araenal, Salary competitive. Recent Ph.D.s are invited to send reiume, research plans and names of four reference: Academic Affairs, University of Alabama in Hunts-

Equal opportunity in education and employment.

Solid Planet Geophysicist/Texas A&M University. The Department of Geophysics at Texas A&M University is pleased to announce availability of a junior level, tenure track faculty position. The department emphasizes solid earth geophysics with concentrations in tectonophysics, geodynamics and internal structure. We are seeking a talented and active researcher and teacher who will comple-ment, strengthen, and broaden current areas of expertise. There are excellent opportunities for interpariment as well as those in the departments of oceanography and geology and in the center for tectonophysics. Qualified scientists are requested to send resumés to Neville L. Carier, Head, Department of Geophysics, Texas A&M University, College Station, TX 77843.

Texas A&M University is an equal opportunity

restdectoral Appointee. Applications are invited for a recent graduate to perform research on the exchange of gasses and fine particles bet the almosphere and the surface of the earth. A Ph.D. inmeteorology or a related discipline is required and strong research interests in experimen quirod and sirong research interests in experimental micrometeorology is highly desired. Familiarity with instrumentation, electronics, and computer programming is needed. The individual will join a closely-knit research group operating under DOE and EPA sponsorship. Please send resume to: Mr. Mickey Brown, Box RER-80, Argenne National Laboration, 2700 So. Case Avenue, Argente III. oratory, 9700 So. Cass Avenue, Argonne, IL

An affirmative action/equal opportunity employer Women Minorities, the handicapped and veterans

Groundwater Hydrologist and Associate/ Assistant Professor, tenure-leading. Devolop and conduct a strong rosearch program (75%) in groundwater hydrology as related to irriga-tion. Perform research on the effects of various irrigation management programs on soil water move-ment and groundwater storage. Might include mod-eling the hydrologic system associated with the unsaturated volume below the crop rooting zone as unsaturated volume below the crop rooting zone as well as the water saturated portion. Also teach (25%) two advanced groundwater hydrology courses and basic descriptive hydrology course. Requires Ph.D. in engineering, hydrology, geology or related field with strong background in mathematics, flow in porous media, computer science, groundwater hydrology, optimization and irrigation. Apply with resume and three names of references by April 1 (or until suitable candidate is found these. by April I (or until sultable candidate is found thereliter) to: Dr. William L. Powers, Director, Nebraska Water Resources Center, 310 Agricultural Hall, The University of Nebraske-Lincoln, Lincoln, NE 68583. Affirmative action/aqual opportunity employer. (402) 472-3305.

Structural Geologist. The Department of Geosciences of Purdue University invites application for a tenure track faculty position in structural geology, starting in August 1981. Rank and safery will be commensurate with qualifications. A Ph.D. is required. The individual will be expected to teach undergraduate and graduate courses in structural geot-ogy and tectonics, participate in summer field courses, and pursue an active research program. Preference will be given to a candidate with an applied field orientation and a strong background in the quantifictive analysis of field data. The department has active programs in perrology, geophysics, and engineering geology and has a close working rela-tionship with the geolechnical group in civil angineer tionship with the georechnical group in two engineer-ing and the Laboratory for Applications of Remote Sensing, Closing date for application is April 1, 1981. Applicants should send a resume, the names, addresses, and telephone numbers of three referees, and a brief statement of research interests to R. H. and a bnerstatement of Geosciences, Purdue McCallister, Ospartment of Geosciences, Purdue University, West Lafayette, IN 47907.

Purdue University is an equal opportunity/affirma-tive action employer.

Program Manager/Meteorology. Oceanographic Services, Inc., is seeking qualified applicants for the position of program manager for meteorological studies. Applicants should have an M.S. or Ph.D. in meteorology or almospheric sciences, plus experience in the tield. A broad general knowledge of air pollution, and an understanding of the eir pollution regulatory environment, is helpful. Interested persons should send resume, releisness, and salary history to R. C. Banks, Oceanographic Services, Inc., 25 Castillan Drive, Golota, CA 83:17.

Geophysicist North Carolina State Univer-sity—Raleigh. The Department of Marine, Earth and Almospheric Sciences invites applications for a presently available tenure track position in geophysics. Bank and satary are open, depending on qualifications and experience. A Ph.D. is required. Applied or exploration geo-

physics orientation are preferable; however, other specializations in geophysics also will be considered. Primary responsibilities will include generaling and conducting research programs as well as eaching graduate courses in geophysics. The department currently consists of 31 regular department currently consists of 31 regular faculty members including 18 in the areas of geology and geophysics. Please send resume and names of three references to Prof. I. J. and harnes of unree reterences to Front J. Won, Search Committee Chairman, Departmen of Marine, Earth and Almospheric Sciences, North Carolina State University, Raleigh, NC 27650, USA. We hope to make a final ecision prior to May 31, 1981. North Carolina State University is an equal opportunity/affirmative action employer.

Seismologist and Specialist in Rock Deformation Science: Bernard Price Institute of Geophysical Research, University of the ca. Applications are invited from suitably qualified persons, regardless of sex, race, religion or nationi origin, for appointment to the above posts. Mines in the Witwatersrand Gold Fields are now penetrating to depths of 4 km. The confining strate are strong quartzites. Between 1971 and 1977 the Institute had an active programme of investigating the selamic events which accompany the deep min ing. Many seismic events which accompany me deep min-ing. Many seismological studies were published on these events. Occasionally tremors have exceeded a magnitude 5.0 on the Richter Scale and in recent /ears there have been ten events between M = 4.0 and 4.8. Source mechanisms are similar to those of small shallow earthquakes.

One of the Institute's publications (by Gay and Ordepp) describes a region where a seismic event occurred in advance of active mining. Special excapations are appeared to the fellium recommend to the fellium recommend. vations were created to examine the failure zone and it was possible to ascertain in some detail the structure of this volume of falled rock.

There are heavily instrumented selemic networks—some completely digital—in four of the mining areas. Mine safety records are comparable

The University is now renewing its researches on the seismic source mechanism and its implication We seek a selamologist and a specialist in rock deformation science, to lead further researches in this important sphere, and to collaborate with institutions and University Departments elsewhere in the world who have a special interest in the mechanics of shallow earthquakes. The salary is negotiable, depending on qualifications and experience. Applications should reach the Director, Bernard Price inatitute (Geophysics), University of the Witwaters rand, Jan Smuts Avenue, Johannesburg 2001, South Africa before 31 March 1981; further information on this post may be obtained from him.

Geochemistry/Brittle Deformation, University of New Brunswick. The Department of Geology has a lenure track position available from July 1, 1981 at assistant professor or higher level. The successful applicant will be expected to teach both undergraduales and graduates as well as car-rying out research and supervising graduate atu-

Applications will be accepted in the following fields: geochemistry of ore bodies, exploration, envionmental or soil geochemistry, brittle deformation,

Applicants should have a Ph.D. and preferably, post doctoral experience. Applications including a curriculum vitae and names of three referees should be sent to P. F. Williams, Chairman, Department of Geology, University of New Brunswick, Fredericton, N.B. E3B 5A3.

Faculty Position: Petrology Tectonics. The Department of Geology at Stanford University has an opening for a full professor to work half-time in the fields of petrology and tectonics. We seek someone who is interested both in teaching and in conducting research on the activities; and tradeling conducting research on the petrology and teclonics of continental margins. Applicants are invited to send letter of application, a resume and the names of three references by March 31, 1981 to:

School of Earth Sciences Stanford University Stanford, CA 94305

As an equal opportunity and affirmative action employer, Stanford welcomes applications from women and minorities.

Queens College. Position for 1 -2 years as sab-batral replacement starts September 1981. Special ties requested: geochemistry (organic, environme tal, or exploration); exploration geophysics; groundwater geology. A Ph.D. required. Application suld include c.v. and three references. Send to D. H. Speldel, Department of Earth and Environ-mental Sciences, Flushing, NY 11367. Queens College is an affirmative action/equal op-

Sedimentology: University of Minnesota. The Department of Geology and Geophysics invites applications for a temporary faculty position in recent actions to the Control of in recent sediments starting September 1981. This is likely to become a tenure track assistant professor position starting fall 1992. Opportunities exist for interaction with the Limnological Research Center and with active research programs in paleoscology, paleomagnetism, hydrogeology, and low-temperature geochemistry, as well as with the St. Anthony Falls Hydraulic Laboratory. Ph.D. and strong interest in research are required. Resume, state-mant of research are required. Resume, statement of research interests, transcripts, and three letters of recommendation should be sent by March

Or. Anita L. Crewa
Sedimentology Search Committee
Oepartment of Geology and Geophysics
University of Minnesota
108 Pillabury Hall
Minnespolls, MN 55455
The University of Minnesota is an equal opportunity educator and employer and specifically invites and encourages applications from women and minorities.

Director: Meteorology Division, Air Force Geophysics Laboratory. Air Force Geophysics Laboratory invites applications for the position of Director of the Meteorology Division located at Hanscom Air Force Bass, Massachusetts. The Division is reasonable for Air Force research and deriansom Air Force Base, Massachusetts. The Sission is responsible for Air Force research and development in meteorology, atmospheric physics, remote and direct sensing technology, climatology, and relative technologies. The division director provides overall direction to an H&D program which semploys over 80 people and covers a broad range employs over 80 people and covers a broad range of in-house and contractual scientific investigat A candidate should have a record of distinguished A candidate should have a record of distinguished achievement in meteorology/atmospheric physics as a research scientist and menager of a substantial R&D unit. This position is Air Force Sentor Executive Service with a satery range of \$52,247 to \$57,973, subject to current \$50,112 celling. For an application package, call collect: Robert Ellerin, (617) 881-2896; To be considered, applicatione must be returned by 30 April 1981.

Equal employment opportunity employer.

Faculty Position Economic Geology

The Department of Geology, University of Georgia, has a tenure track opening in economic geology. Rank and compensation are open through the

Duties include (1) teaching courses in exploration geochemistry (2) supervising M.S. and Ph.D. candidates, and (3) developing a strong research program with significant field commitment.

Teaching and research interests in one or more additional fields such as ore deposit mineralogy, reflected light microscopy, theoretical geochemistry of ore deposits, fluid inclusion research, hydrogeochemistry, or environmental geochemistry are desirable

An applicant should submit a detailed curriculum vitae and have at least three letters of recommendation sent to F. Donald Eckelmann, Head, Department of Geology, University of Georgia, Athens, Georgia 30602. The deadline for receipt of applications is May 1.

The University of Georgia is an equal employment opportunity/affirmative action institution.

Postdoctoral Fellowship in Experimental Petrology at UCLA. Starting approximately September 1, 1981, an up to 24-month appointment in phase equilibrium research, chiefly hydro-thermal synthesis, will be available. Candidates should possess Ph.D. Send letter of application and arrange for two confidential recommendations to be forwarded to: W. G. Ernst, Earth and Space Sciences, University of California, Los Angeles, California 90024.

UCLA is an equal opportunity/affirmative action

Upper Ocean Modeler. Two postdoctoral po-sitions in upper-ocean modelling available in the mesoscale air-sea interaction group at the Florida State University. Ph.D.'s with background in fluid dynamics, theoretical physical oceanography, dynamic meteorology, numerical acadysis, or physics are invited to apply. Salary range \$19,000 – \$21,500/year. Positions are supported by Office of Naval Research and may be filled at any time after April 1, 1981. Send vitae and names of three references to Professor James O'Brien, The Florida State University, Tallahassee, FL. 32306.

The University is an equal opportunity employer

Dean of Sciences and Mathematics/Hunt-er College, City University of New York. Challenging position evallable July 1981, in dy-namic urban institution. Strong doctoral research programs, extensive federal funding, major com ment to women and minorities, MBS and MARC programs, stable enrollments, major expansion of facilities in progress, attractive midlown Manhattan location. Send resume and names of three references to Chair, Search Committee for Dean of Sciences and Mathematics, Box 447, Hunter College, 695 Park Avenue, New York, NY 10021.

Research and Data Systems, Inc./Scientific Programmers and Programmer Analysts. Immediate openings for persons with B.S. in science or math and at least two years experience with FORTRAN or PL1 on IBM systems. Work involves data processing and analysis from satellite based remote sensing systems. Experience with time sharing systems preferred. Also have openings for staff scientists with strong programming back-ground. Send resume in confidence to Research and Data Systems, Inc., 9420 Annapolis Road, Lanham. Geophysicist/Structural Geologist, Albion Cellege. At source track position, commencing Fall 1981, is open at the assistant professor level at Albion College's Department of Geological Sciences. The position involves teaching undergraduate laboratory courses in structural cellogical and combining. ratory courses in structural geology and geophysics and introductory lab courses or non-lab courses in geology. The Department is developing a geophys-ics/geology major and has some geophysical equipment. Candidates with a Ph.D. or who are

about to acquire a Ph.D. are preferred. Depending upon the applicant's background, the new staff member may have the opportunity to assist in teaching at Albion's geology field camp for additional remuneration. A 8-week aummer field methods course is offered to students from many

colleges and universities at the field camp located in the Front Range near Boulder, Colorado.

Albion College is a co-educational liberal arts college located in southern Michigan, an hour's drive from Michigan State University, The University of Michigan and Western Michigan University. The Department has four staff members and 30 to 40 majors: It is a well-equipped department occurring majors; it is a well-equipped department occupying a floor-and-a-half of a new science center. Resume, transcripts and three letters of referance should be submitted to: Prof. Lawrence D.

Taylor, Department of Geological Sciences, Albion College, Albion, Michigan 49224.

Albion College is an equal opportunity employer.

Exploration Geophysicist/University of Oklahoma. The School of Geology and Geophysics at the University of Oklahoma will hire an experienced exploration geophysicist to fill the Frank and Betty Schuliz Professorahip, and is seeking nominations and applications for the position. The person must be a distinguished scientist who has made important contributions to exploration goo-physics through research. Preference will be given to a scientist whose specialty is setsmic properties of earth materials and who has carned the Ph.D.

The Schultz Professor will provide teadership and guidance in establishing a quality teaching and research exploration geophysics group. The University of Oktahoma has recently made a strong commilment to the earth sciences with the establishment of a College of Geosciences, to be housed in a new building. The School of Gaology and Gao-physics will expand from its present faculty of 16 to 26 faculty members by 1986. This will include three scientists in the exploration geophysics area, five in structure-toctonophysics-solid earth geophysics and others in straligraphy-paleontology, geochemistry-petrology, and energy resources.

Applications are due April 30, 1981. Inquiries, nominations, and applications should be sent to John Wickham, Director, School of Geology and Geophysics, University of Oklahoma, Norman, OK

The University of Oklahoma is an equal opportu-

Oceanographic Mooring Technician. The Marine Science Program at North Carolina State University (Raleigh) is expanding its oceanograph echnical services group and is currently seeking a technician lamiliar with the design and deployment of deep-sea current meter mooring arrays, as well as with standard shipboard oceanographic sampling

techniques.

Qualifications include a degree in science or engineering with some electronics background and two years field experience or an equivalent combination of education and experience. Salary commensurate with education and experience. Send resume and Carolina State University, P.O. Box 5067, Raleigh,

An equal opportunity employer

SERVICES

Geothermal Resource Maps. The Department of Energy, Division of Geothermal Energy (DGE), in cooperation with NOAA's National Geophysical and Solar-Terrestrial Data Center, announces the publication of geothermal resource maps of Idaho, Colorado, Utah, New Mexico, and California, as well as a "Thermal Springs List for the United States." Those publications are part of the DGE's State Resource Assessment program. These maps are designed to communicate to a user the relationship of natural thermal features. thermal wells, and areas considered to have a high probability of encountering additional geothermal resources to cultural teatures and land-use categories, such as parks, wilderness areas, national fo ests. Native American lands, and Department of

State goothermal resource maps of Washington Montana, North Dakota, Texas, Oregon, Arizona, Nevada, Wyoming, Virginia, Nebraska, Alaska, Kansas, Oklahoma, and Hawali will follow in the fu-

If you wish to obtain these products, sand your name or card, your affiliation, and your address to NOAA NGSDC, Date Mapping Group, Code D64.

Meetings

Gordon Research Conferences

Four of the Gordon Research Conferences scheduled for this summer will include discussions of interest to geophysicists. Emphasis at each conference is on the free exchange of ideas. One requirement of the conferences, for example, is that no information presented be used without the specific authorization of the individual making the contribution. The conferences, initiated by Neil E. Gordon 50 years ago, are self-supporting.

A session entitled 'Environmental Sciences: Air,' is scheduled for June 15-19 at the New Hampton School in New Hampton, New Hampshire. Jack G. Calvert will chair the conterence.

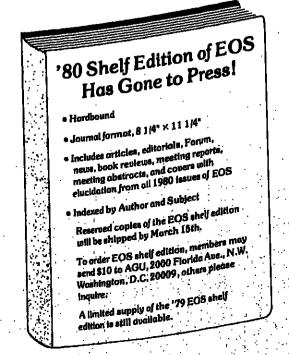
Martin Walt will chair the conference on 'Collisionless Shocks in Space, Astrophysical, and Laboratory Plasmas, scheduled for June 22-26 at the Brewster Academy In Wolfeboro, New Hampshire.

'Fluids in Permeable Media: Physics and Chemistry' will be the topic of the conference August 3-7 at the Tilton School in Tilton, New Hampshire. R. L. Reed and R. S. Schechter will preside.

Marco T. Elnaudi and Hiroshi Ohmoto will cochair the session on inorganic geochemistry, slated for August 17-21 at Colby-Sawyer College in New London, New Hamp-

Attendance at each conference is limited to about 100 conferees. Application forms, available from the director's office, must be submitted in duplicate. A registration card will be malled to those selected. Advance registration is

Applications and additional information can be obtained from Alexander M. Cruickshank, Director, Gordon Research Conferences, Pastore Chemical Laboratory, University of ^{land}, Kingston, Rhode Island 02881. 🕸



The Fourth Conference on the

Physics of the Jovian and Saturnian Magnetospheres

will be held at the

Applied Physics Laboratory The Johns Hopkins University

October 22 - 24, 1981

Voyager I and 2 and Pioneer II Results and Theoretical Interpretation will be Emphasized

Program Committee:

(Goddard Space Flight Center)

(University of Florida) T. D. Carr T. W. Hill

D. M. Hunten (University of Arizona)

F. L. Scarf CLRW Systems) G. L. Siscoc

S. M. Krimigis

(University of California) E. C. Stone

Curversity of towar f. A. Van Allen

For further information, please contact:

S. M. KRIMIGIS APPLIED PHYSICS LABORATORY THE JOHNS HOPKINS UNIVERSITY LAUREL, MARYLAND 20810

An application for admission to the UNM Graduate Program, transcripts, Graduate Record Exam results (verbal, math & geology), three letters of reference and a brief statement of research goals are required for consideration for the followships. Application materials may be obtained Rodney C. Ewing Department of Geology Albuquerque, New Mexico 87131

Ç,

Distinguished Professorship in Geology

to invite nominations or applications for the Caswell Silver Distinguished Professorahip in Geology. This endowed professorship shall be awarded for periods of up to two years to earth scientists of distinguished accomplishment and international regulation. The professorational regulation of the professoration of the professorat guished accomplishment and international reputation. The professorship may be held by scientists of all specialties of the earth sciences in the broadest sense, and the major criterion for selection is that the individual be an active, productive leader in his or her field of research. The recipient must carry out a vigorous research program while in realdence at UNM. The recipient is expected to interact with the faculty and students of the Department and to provide one or more seminars, in an advanced topic of his/her choice, during each academic year. The Foun-

dation will provide unusually advantageous remuneration commen-dation will provide unusually advantageous remuneration commen-surate with the distinguished nature of the appointment. In addition, a generous allocation for travel and operating expanses (to include secre-tarial support, analytical services in department taboratories, use of field vehicles, and preparation of manuscripts) will be provided. Applications or nominations should include a detailed resume and brief statement of major research accomplishments. Applications or nominalions should be forwarded to:

Rodney C. Ewing, Chairman Department of Geology University of New Mexico Albuquerque, New Mexico 87131

The Caswell Silver Foundation is an equal opportunity

(301) 953-7100 X3252

1.65

() ·

Call For Papers

AGU is issuing a call for papers for the 28th Pacific Northwest Regional Meeting to be held at Central Washington University, Ellensburg, Washington, on September 17-

The purpose of the regional meeting is twofold: to inform the geophysical community about the research conducted within the region, regardless of the specialty, and to report what is known about the region, regardless of the location of the individual or institution conducting the research. Progress reports and student papers are encouraged. Field trips are planned for before and after the meeting to examine strike-slip faulting in the Cascade Range and Columbia

Symposia

Special symposia will be held on 'The Tectonics of the Columbia Plateau and Other Neogene-Quaternary Faults of the Pacific Northwest, on 'Stratigraphy and Structure of the Cascade Range, and on Studies of the Eruption of Mount St. Helens.

Accommodation and Travel Information

Central Washington University is located 2 miles north of interstate 90 in Ellensburg, Washington, 40 miles north of Yakima, and 110 miles east of Seattle. The Yakima airport is served by Republic and Cascade airlines, with connecting flights to Seattle and Portland. On request, shuttle vans will be provided from the Yakima Airport to Central Washington University. Accommodations will be available at CWU Conference Center at low costs.

Plans for field trips that will begin in Portland on September 14 and and in Seattle on September 21 are being formulated and will be announced in early summer. Advance registration forms and transportation information will be distributed in August.

0

4

Ç

The deadline for abstracts is July 15, 1981, and they must be submitted in the standard AGU (see page 20 of January 13 Eos) format.

Abstracts should be typed single-spaced with a dark ribbon so that they can be legibly reproduced by the Xerox process. Mathematical symbols may be handwritten with India link or black ball-point pen. The text should be limited to the most important information: a clear statement of the problem, the method of solution, and the results obtained. It should not be just an expanded title, with statements such as '... will be presented' interspersed. The maximum dimensions of the abstract are 10.4 cm by 20 cm.

Authors assume responsibility for accuracy of the data

Travel Grants to IAGA and IAMAP Scientific Assemblies

Deadline for Applications: April 1

AGU has applied to the National Science Foundation for grants to assist the travel of individual U.S. scientists to the Fourth Scientific Assembly of the International Association of Geomagnetism and Aeronomy, to be held in Edinburgh, Scotland, August 3-15, 1981, and the Third Scientific Assembly of the International Association of Meteorology and Atmospheric Physics, to be held in Hamburg, Germany, August 17-28, 1981. Application forms for the grants are available from

> Member Programs Division American Geophysical Union 2000 Florida Avenue, N.W. Washington, D.C. 20009 (Telephone: 202/462-6903)

submitted, and the secretary-treasurer is responsible for correct reproduction. To facilitate his job and to avoid mistakes, please put the author's name and the title of the paper on every sheet submitted.

Send the original plus two copies to Bob Bentley, Secretary-Treasurer, PNAGU, Central Washington University, P.Ó. Box 1000, Department of Geology, Ellensburg, Wash-Ington 98926. He will distribute copies to the appropriate

Available as standard equipment are single 35-mm slide projectors and overhead projectors. Unless otherwise specified, 15 minutes (10 minutes for presentation and 5 minutes for discussion) will be allowed for each paper. Authors are encouraged to bring preprints of their papers for distribution to the audience. 🕉



Additional special session: Oceanography

lydrothermal Processes at Ridge Flanks I. (Chairmen: Marcus R. Langseth and Johnson R. Cann) II. (Chairmen: Richard P. Von Herzen and Michael L. Bender)



1980 Fall Meeting Report

About 2430 participants registered for the 1980 Fall Meeting, the largest attendance yet at a Fall Meeting; 1659 papers were presented.

The special session on the 1980 eruption of Mount St. Helens, presented by Robert L. Christiansen, and the one on the Voyager I encounter with Saturn both drew close to 1500 altendees.

Other highlights were Clyde Warhaltig's field trip on the Sunday before the meeting; the unofficial Fun Run, the results of which were published in the January 27th issue of Eos; and the section luncheons.

For whoever missed the field trip this time, there is another in the works for the 1981 Fall Meeting. Changes and late and revised abstracts are printed be-

Papers Not Presented

GP13, R. T. Merrill and G. M. Smith. H39, C. A. Quesada-Mateo; H80, M. Deltinger; H100, C.

M14, C. L. Korb el al.; M15, E. J. Hurley et al.; M25, G. L. Kok et al.; M36, J. G. Norton; M51, T. Hinkley; M56A, M. M. Millan et al.; M61, R. L. Lehman; M64, E. Bauer; M85, C. E. Buell and R. C. Bundgaard; M67, C. McDonald et al.; M101, R. G. Fowler; M102, E. P. Krider et al.; M113, J. M. Rosen and D. J. Holmann.

O6, B. R. Pearce and A. C. Humphreys; O28, T. C. Moore, Jr., et al.; O30, A. L. Gordon; O35, A. D. Socci and M. A. Sommer, II; O41, Y. Hsueh and L. Vansant; O53, R. O. R. Y. Thompson and T. J. Golding; O88, R. E. Wall; O99, S. Aranuvachapun; O118, M. Styrt and H. D. Holland; O128, K. Wyrtki; O173, K. M. Kulvila and J. W. Murray; O195, S. MacIntyre and J. M. Melack; O247, M. Rattray, Jr., et al.; O248, C. Frankignoul; O258, S. D. Chapnick et

S15, J. Regan and H. Kanamori; S19, T. H. Healon; S26,

SA2, K. V. Chance and W. A. Traub; SA26, L. E. Wharton and N. W. Spencer; SA37, M. R. Torr et al.; SA42, R. O. Olsen: SA75, R. D. Harris.

SC11, S. P. Agrawal; SC16, R. Reinhard; SC20, G. M. Mason and H. Weiss.

SM117, T. Sato and A. Hasegawa; SM153, L. C. Lee et al.; SS7, M. Heinemann; SS27, W. K. H. Schmidt et al.

Postdeadline Abstracts

VANIABILITY OF GEDID AND OCEAN SURFACE SPECTRA FACH SEASAT-1 ALTIMETER DATA

R.D. Brown (Phierds Corporation, 1766 Old Medicine Road, McLean, VA (2161) W.D. Kahn (Caodynamics Branch, Codidard Space Flight Center, Greenbell, MD (2071) R.E. Meswith (Phoenis Corporation 1730 Old Medice Road, McLeen LA (2018)

The Serial rider altimeter data elfords a original cyloperturity for determining and serious cyloperturity for determining and secretarity for determining and secretarity from the spectra of the series phyroseans. The Seried 3 day respecting sobile quarastics is measure of the sere queed but generally different occan surface timeture on successive repeating and series of the sere queed by generally different occan surface timeture on successive repeating are suffered to the series of the power spectra of the scools series and being the face the series phenomen. By averaging repetitive data sects, the spectra of the good series of the sects of the good sects. The residual good power on save, leading shorter from 1 and observed from the section of the good spectra and injecting from 1 and of the good spectra and sects and sects. The spectra of the good spe

tidal and mesoscale ocean phenomena. These results have implications for planning of goodynamics and ocean observing satellite

COLLEGIA BIVER VATER VITHDRAVAL STUDY

Jeffrey B. Statley (Mydrolagy Section, Pareland District, Corps of Engineeral

The Columbia Biver is a complex and heavily utilized restricted by the in the past appeared to be unlimited. Now it is evident that the system will be unable to continue to completely serve its many diverse was such as frigation, flood control, bydeopouse, savigation, flash migration, and restraction. Diverse, interval and interval of the and wishin the tasks affect water quality, flesh and wishing behind, and fest and account factors influencing the quality of but from this paper protects the state of the art of bydrologic modeling for multi-purposes use and aboverages a terfaique developed for the Columbia Fiver Water Withdrawal Environmental Rayley maigraing effects of additional irrigation in the region.

basiyate, difects of additional irrigation in the region.

Sameline conditions, and two hyperbasical levals of increased trigation development wars extendished. A hydrolysic model of the Columbia Siver system, the Hydrolysiche Mannool Regulation Frogram (MYSSM), was used to missisting own requirementalism and those tempor projects under rapying load and flow emoditions owns on an amended time period. This model allowed by to emission our threat democition as it prepared by the emission of the model of the period.

al.; O281, J. J. Tsal and J. R. Pronl. P12, G. Schubert and J. M. Straus; P34, M. A. Lange.

S. A. Alsinawi; S69, Y. Yu-Rong; S70, C. Zu-huang; S73, C. Shuhai, et al.; S91, M. Takemura and J. Koyama; S133, D. W. Rivers and Z. A. Der; S184, C. A. Salvado; S196, B. Chouet; S207, J. Mwenliumbo and H. H. Schloessin.

SM64, P. A. Isenberg; SM68, U. S. Inan and T. F. Bell; SM97, H. Balsiger et al.; SM99, A. Ghielmetti et al.; SM176, R. J. Walker; SM212, A. F. Cheng and B. Altner.

T11, C. Schubert; T33, T. J. Ahrens; T57, G. T. Nixon. V51, J. Ach and S. E. DeLong; V59, S. Self and M. R. Rampino; V69, M. R. Perfit et al.; V124, J.

atraints placed on the system by other water acraints placed on the system by other water uses, neet importantly irrigation. 1955K is a model limited to the mainston Columbia and Snake Rivers which allows us to assess large level irrigation depletions. A future stap required in order to best manage water resources in the hydrologic modeling of apecific Columbia River tributeries at increase development levels.

H 46A (INVITED PAPER)

ERCHION OF REDINENTS BELEASED BY THE 1980 ENUPTIONS OF MY, ST. HELZMS Andre Lahts, Thomas Dunne, Les Fairchild, Brian Collins (Dept. of Geological Sciences, University of Mashington, Seattle, VA 98195)

University of Manhington, Seattle, WA 98195)

The 1980 eruptions of St. St. Melvas emplaced the following sediment in the Toutle River valley; avaianche deposite overleis by thin modilow and pyroclastic deposite; modilow and pyroclastic deposite; modilow and pyroclastic deposite; modilow deposits; tephres; and deposite from the subbufuscal blest. The unite have been supped and their standlowestry quantifised. They differ steam lowestry quantified. They differ size and succeptibility to fluvial transport, find measurements of the mode and volume of erosion in each unit ruggest that the major long-term sediment sources for the Toutle River are likely to be disseation and landsiding along sajor guilies on the avalanche deposit in the Borth fork Duttle valley and in caryons at the head of the South Fath, and removal of such from slopes that pare been cleared by legging or by the supplies. The crosion of sah is proceed-ing. Manaturements of residual forms generated

Annual Meeting flight reservations YOUR TOLL-FREE

"HOT LINE" NUMBER 800-323-0639

(In III. 312-569-3375) limited discounted seats available

avoid fare increases

Arrangements have been made with United Airlines for a United Specialist to assist you with your flight reservations when you phone the above number. Call Monday through Friday, 8:30 a.m. to 5:30 p.m. for this special convention service.

by these last two processes silow calculation of the volume of sub removed under a variety of gradients and a range of sub testure during light appring rains. The measurements also suggest the distribution and magnitude of aro-sional processes during future wat seasons.

H 46B (INVITED PAPER)

PIRLD EVIDENCE FOR THE DYNAMICS OF THE TOUTLE RIVER HUDDILOWS, MAY 18, 1980

Mark Wigmosta, Lac H. Fairchild, J. Dungan Saith, Thomas Dunce, Peter Flansgan (Dept. of Coological Belences, University of Washington, Seattle, WA 98193)

Seattle, WA 98195)

Superslavation of mudlines around 15 bands in the Morth and South Forks of the Toutle valley indicate average valocities of 7 to 29 m/s at past discharge for the mudflows tringered by the May 18 supplies. Discharges computed for cross-seations along the valley are completed and give confidence in the estimated velocities. The sudflows broke tross in many of these bands and the maximum dismaters of the snapped trusks are correlated with valocities computed from superslavations. Broken trees are then used to calculate velocities in straight reaches, as well-as to determine the latural profile of valocity screes the valley. Directions of bresham indicate flow lines in bands, including in some cases the development of large eddies. This field date provides an espectial strong constraint on the constitutive squarious now being developed for the Toutle Rivor modificate.

For your AGU

call for details

Analyses of the volstile materials released at room temperature from Mr. St. Helens volcanic ash have consistently shown for a wide variety of samples, representing eruptive events both prior to and after the May 18 cruption, that the following trace games are present: CO2, CO, CS2, CO3, SO2, CR3C1, Chipt, CR31, CRC1, and CCL. In addition, a variety of more complex organic compounds have been identified thyl chloride, acatome, dibromochloromethane, and a wide spactrum of unidentified relication and hydromethons. The spacies detected are not believed to be due to contamination related to relication or handling procedures. Analysis of the complex array of games measured in the headspace above the same amples suggests that many of the species do not represent a simple description of the previously admorbed uncertail. Eather, comparison of results of samples subjected to thermal studies verms photolysis indicate that many of the species wessured (i.e., CO2, CO, CH3C1) are being produced by IV irradication breaking down higher molecular weight compounds admorbed on the ash. The sah is a highly admorprive material and has been observed to readily admorb from the sir both low molecular weight empounds the polynuclear aromatics, i.e., maphtheiste, anthrocane, atc. Further work is in progress to explain the observed phenomens and will be reported at the meeting. SPECTROSCOPIC MEASUREMENT OF 802 VOLCANIC EMISSIONS Millen, Millen M., (Barringer Research Ltd., Toronto, Onterio Canada) Gallant, Allan J. and Panaki, Found Atmospheric Environment Service, Environment Canada, Toronto, Ont. Canada

ANALYSIS OF TRACE GASES FROM HT. ST. HELENS VOLCANIC

R<u>. A. Marruseen</u> (Oregon Graduate Gantar, Beaverton, Oregon 97006) N. A. E. Khalil, S. A. Penkett, and T. Camadovalia

(Sponsor: Thomas Casadevall) Correlation Spectrometer (COSPEC) remote sensors have been now routinely used to wonitor SO2 emissions from volcances and have played an important role in the forecast of Mt. St. Helens activity after the May 18th eruption.
The instrumental operation

The instrumental operating characteristics will be briefly characteristics will be briefly described exphanizing the atmospheric effects on the 802 measurements.

Experimental observations of the Mt. St. Nalens, May 18th, S0-cloud over Southern Ontario will also be

DOPPLER SPECTRA OF LIGHTNING ECHOES WITH A VERTICALLY POINTING RADAR

Don MacGorman (CIMMS, University of Oklahoma, Morman, OK 73019 Dusan S. Zrn[c', (NDAA, Mational Severe Storms Laboratory, 1313 Halley Circle, Norman, OK

W. David Rust, (NOAA, National Severe Storms Laboratory, 1313 Halley Circle, Norman, Or Milliam L. Taylor, (NOAA, National Severe Storms Laboratory, 1313 Halley Circle, Morman, OK

Digital time series data at 16 heights through the storms were collected with a 10-cm Doppler radar at vertical incidence. On several occasions during data collection, lightning echoes were observed as increased reflectivity on an oscilloscope display. Simultaneously, lightning signals from nearby electric field change antenness were recorded on an analog recorder together with the radar echoes. Reflectivity, mean velocity and Doppler spectra were analyzed for time series before, during and after lightning dischance. Spectra from locations where lightning channel as it follows the air speed. Thase pasks are considerably neurower than the ones due to precipitation. In some instances, the channel extends over a kilometer in depth. Besides providing a means of measuring the vertical air velocity that can then be used in estimates of dropsize distribution, the lightning spectra provide a convenient means to estimate the radar cross section of the channel. The relationship between lightning occurrence and subsequent changes in the reflectivity and Doppler spectrum width is also examined.

AN EFFECT OF THE CIRCULAR POLARIZATION ON THE LICETHING DETECTION

V. Marur (Electrical Engr. Dept., University of Olidowa, Norman, OK 73019) G. Walkar (Electrical Engr. Dept., University of Oklahoma, Horman, OK 73019)

Ollahora, Horman, Ok 73019)

The effectiveness of detecting lightning with linearly polarized (LP) radar is a function of the frequency band. At L-band (1300 MEM; echoes from the heavy precipitation regions often mask a hig percentage of lightning events. To raduce this problem, the circular polarization has been proposed. The effect of the circularly polarized (CP) radar on the lightning detection is investigated both theoratically and experimentally (radar F73-8, 1-21 cm). The theoratical malysis is based on a rigorous solution of the wave equation for a dielectric cylinder of infinite length and oblique angle of indidence. Four series of observations of 4-5 minutes obtained white switching polarization (LP and CP) show an effective reduction of the precipitation enho relative to the lightning echoes. As a result, the total number of recognizable lightning schoes is increased, aspecially outside of a heavy precipitation care region.

0 63A (INVITED PAPER)

POLLUTANT RESPONSES IN MARTHE ANIMALS (PRIMA) R.F. Lee (Stideway Institute of Oceanography Savannah, Georgia 31406) (Sponsor: Rodger Bajer)

(Sponsor: Rodger Baier)

The objective of PRIMA is to define morphological, biochemical, and physiological indices that can be used as diagnostic tools to detact significant chemical impairment in marine animals. The approach of PRIMA is to assess responses of selected marine animals to assess responses of selected marine animals to processes be studied in an integrated, combinate processes be studied in an integrated, combined animals. Thus, our interdisciplinary approach is designed to define important physiological processes to variation in chemical and physical conditions.

The belogical processes and effects studied include accumulation and release kinetics, biotranscoutered and related stress responses, ascorbic and metabolism, histopathology, histochemistry, and immae computence (defense mechanisms). Technologus to measure pollutant effects are being develoption will be used to assente stressed and standardized under laboratory conditions and field populations.

field oppulations.
Studies of bleaccumulation and depuration of solutions by the selected animals were carried out or are in progress. Biotransformation studies have centered around cytochrome P-450-dependent hixed function oxygenase (NFO) systems. Engages in duction and/or altered spectral properties of cytochrome P-450, were observed in microsomes of class, crabs, fish and worms exposed to the pollutants.

Metabolic products of several pollutants formed by these species were identified. NPD systems and changes with normal variables (such as sex and season) that effect cytochromes P-450 are being

O 63B (INVITED PAPER)

endvetar tover experiment: Sea-air exchange Program (Searex)

R. B. Gagosian and G. C. Zaitriou (Chamistry Department, Moods Hole Oceanographic Institution, Woods Rois, Mass. 02543 USA) R. A. Duce (Gradusta School of Decenography, University of Rhode Island, Fingston, R.I. OJBS; USA) J. M. Prospero (Resenstial School of Harins and Atmospharic Sciences, University of Missi, Fis. 33149 USA)

One of the main objectives of the SEAREX Program has been to detormine the sources and fluxes of atmospheric particulate matter found in the oceans. One approach we have taken in acceptiating this objective has been to collect atmospheric particulate matter from 20 m towers in the morthern and southern trade who regime and to analyze this matterial for organic and inorganic components which provide source marker information for retreatful, marine or atmospheric reaction inputs. The first such apperigent was conducted in the mortheset crade winds on Bokandratok Island, Enswetak Acoli, Marshell Islands (tom April to August, 1779.

The results of this investigation revealed a large number of continentially-derived particulate organic compounds. Over the five month particulate organic compounds. Over the five month particl, a factor of 3-7 decrease was found for the organic compounds indicative of terrestrial origin (C₂₀-C₁₆ odd chain n-alkanes; C₃₀-C₃₂ even chain fatty alcohols and fatty acid estors and saits). Ratios of Ye/Al, Sc/Al and Mn/Al wers found to be very similar to mean crustal ratios. The atmospheric similar concentration (used as an indicator of continental dust decreased by a factor of 50 over the course of the superiment.

Retworkingle-1 of time tuples in a such content.

Naturological and climatological acudios show that large amounts of dust from China wore probably transported during April-Nay into the Emporal area by a very attong westerly flow of wind at 700 th followed by a subsidence into the trade winds wast

O 63C (INVITED PAPER)

The Vertex Program

John H. Martin (Moss Landing Marine Labora-tories, Moss Landing, California 95039)

The Vertus program is made up of a small group of scientists interested in studying the yortical transport and onlongs of mare-fals in oceanic water column. One of the ains of the program is to learn core about how the "stating particle" transport system how the "sinking particle" transport system works; i.e., by studying the primary particle producers (phytoplankton), the large, fast-sinking particle producers (zooplankton) and the particle decomposers (zicroorganisms), invelation to the environments these organisms inhabit. Studies on the transport system are coupled with flux measurements used with particle interceptor traps set throughout the uppor 2000 m of water column. Elements and compounds that are being measured in water and in trapped particulates include [, N, F, trace elements, organic compounds [lipids. organic N, pollutant and biogenic hydrocarbons), natural series radionacilides and transurantes. The various compounds and transurantes. The various components and how they interrelate will be described. Initial results from the first cruise will be presented, along with plans for future field efforts.

O 630 (INVITED PAPER) MANOP: IN SITU STUDIES OF ELEMENTAL FLUXES AT THE DEEP-SEA FLOOR

G. Ross Heath (School of Oceanography, Oregon State University, Corvellis, OR 97331) Ray F. Weiss (Scripps Institution of Oceanography, University of California, San Diego, CA 92093)

To assess factors governing the formation and transition-metal goothemistry of deep-sea ferromanganese nodules, MANOP is measuring nutrient and elemental fluxes at five Pacific sites encopassing the adjor pelagic sediment types. Fluxes being measured include dissolved species in bottom and pore waters, vertically settling particulates, and deposition in sediments and nodules. The innovative aspects of the program are the tight coordination of the various measurements, and the use of a sophisticated Botton Lander to carry out experiments at the sea floor. The Lander's capability to add or remove alimpost or measure properties in three "bell jars" on the bottom can be controlled via an acoustic link to the surface, or via preprogrammed instructions stored in an integral microprocessor system. At the end of an experiment, the Lander collects the sediment beneath each chamber or "bell jar", jettisons a ballast plate, and floats to the surface.

O 238A (INVITED PAPER)

Manganese Cycling in NE Pacific Equatorial Maters

John H. Martin (Kess Landing Marine Labora-tories, Moss Landing, California 95039) George A. Knauer [Moss Landing Marine Laboratories, Moss Landing, California 95039)

Particles trapped at depths of 125, 275, 525 and 900 m in ME Pacific equatorial \$25 and 900 m in Ne Pacific equatorial waters (2000 to offshore) were analyzed for their Mn content. Observed fluxes, resulting from these data, increased steadily,with depty, from 300 st 125 m, to 385 mg Mn cm 1000 yr at 900 m. The continuous gain to Mn flux eccurred in spite of large total particulates and organic C flux decreases occurring near the surface (from 7.2; 2.3 at 125 m to 2.4; 0.7 g cm 1000 yr at 275 m for total dry particulates and organic C, respectively). The marked reduction in organic C, amounts resulted in an elevation of molar MgC ratios from 2.8 x 10 at 125 m, to 1.2 x 10 at 175 m.

Tailos from a care a transfer on the four near-surface the first measurements, a bettee the first of 460 us on 1000 yr was estimated. Of this Pa, 953 was scavenged from the water column; measured acted dissolved the reserval rates, were, highest near the surface (-5.5 mg liter yr gt 100, m) and lowest at depth (-0.1) mg liter yr at 4000 ml. The measured and estimated the transport rates indicate that a major portion of the lin accass found in open ocean sediments is derived from near-surface vaters. The ingut source appears to be surface current advect of dissolved Mn originally released via continuate weathering procession.

O 254A (INVITED PAPER)

STUDIES OF NETHANE OXIDATION IN ABOXIC MARINE w.S. Resburgh (Institute of Marine Science, Univ. Aleska, Fairbenis, Alaska 99701)

Ansarobic mathung ordifaction has been suggested as process occurring in anoxic parine sediments. The process appears to be a general feature of marine sediments and consumer casestially all of the upward mathematical. Slope changes in the depth distributions of mathune, carbon direction of aulfate suggests that the reaction occurs is a subsetface mone. A minimum to depth distributions of the stable carbon income

is carbon dioxide, located at the depth of the above slope changes, appears to be caused by lo-cal injection of isotopically light, methane de-vived exchanged

This presentation describes the methods used and gives results of tracer experiments on an-aerobic methase oxidation. These experiments involved addition of CU, so letions to undis-turbed addition of CU, so letions to undis-turbed sediment cores from Skan Bay and Chess-peaks Bay. The results indicate that amerobic methane oxidation does occur and that the rates and year duch distributions on factorial with and rate depth distributions are to accord wish

0 254B (INVITED PAPER) ASSOCIATION OF THE HETHARE SEDIMENT-MATER PLOT AND MICROSIAL ACETATE TURNOVER IN ORGANIC-BICH MARINE SEDIMENTS

C. S. Martens (Curriculum to Marine Sciences, University of Borth Carolina, Chapel Hill, N.C. 27514 and Institute of Marine Science, UNC, Morehead City, NC 28557) F. J. Senzens (Sponsor: Larry K. Senzinger)

The measured mathane flux across the sadiment-water interface in Cape Lookout Bight, Mc ranges seasonally from 10-2600 poolses 2-h over a temperature vange of 3-27°C. Nethers and rades-221 sediment gas distribution studies suggest that this flux is largely supported by methons production in an 8-33 cm doop zone underlying sulfate raductog saddrects. Apparent elerobial In an 8-32 cm doop zone underlying sulfate reduction of mathema from meetate in the top 3 cm of this zone seasonally correlates with the rethans flux and ranges from 50-800 uncleil-ih-1. These apparent rates are based on total wet sediment concentration measurements and in vitro labelied actiate incubation experients. Significant methans production from acciate occurs only in sulfate deploted sediment; a depth during July.

O 254C INSTRUMENTAL DETERMINATION OF MICROBIAL TRANS-FORMATION RATES IN THE MARINE WATER COLUMN

Craig D. Taylor (Woods Noie Ocennyraphic Institu-tion, Woods Noie, Hiss. 02561) Kobert B. Gagosian and John J. Molungoski Konos. 0256)

Instrumentation has been developed that will pormit the thred-series measurement of pierobially mediated chemical transfurrations directly in situs. The following automated operations are performed: (a) a one-liter sample in procured frum the batter column into a swringe-like glass incubation chamber and radi-tracers simultaneously introduced, (b) the sample is incubated at the site and depth of pro-uncent and (c) to all subsamples are withdrawn and preserved at 12 spushly spaced the intervals. The instrument is well suited for quantifying traperies in transfer allowed that are in a state of turnover, and for investigating traperied variations in rate of subsamples that are in a state of turnover, and for investigating traperied variations in rate procupes in response to changes in environmental parameters much as light. Experimental investigation the netabolism and turnover of acetate in the possis, pathe water column are undersays.

0.260A (RAVITED PAPER) CRITERIA OF MICROSTAL ACTIVITIES IN MADDIE

renneth H. Sealson, Bradley M. Tebn., and Reinhardt A. Posson (Scripps Institution of Oceanography,

Several criteria are commonly used to impli-cate microbes as causative agents in geochemical processes: (1) the presence of greanisms with the notential to position a certain reaction, (2) the presence of distinctive structures that are the presence or distinctive structures that are decosited as a result of microbial activities, and (3) neasurements of activities in situ in the presence and absence of microbial polisons or inhibitors. However, caution rust be taken in such studies, both in experimental design and interpretation of the data. Quantitation of organisms is subject to methodological restrictions that may lead to false numbers, and the more presence of the organisms does not constitute proof of their activity in nature. Structural analysis is dependent on the formation and preservation of recognizable structures, something that is uncommon with bacteria. Paisons for use in activity measurements must be carefully casted because many interfere directly in geochemical processes. ited as a result of microbial activities

rully tested acases many interfere directly in goodhemical processes.

While any one of the criteria listed above might be considered findequate, when applied together, and with the appropriate cautions, a convincing case for wicrobial involvement can be made. All three criteria have been used in our studies of manganese oxidation in Saantch Inlet, B.C. and the data indicate that bacterial catalysis is a major factor in the oxidation of manganese.

POSSIBLE CLIMATIC STYPHITS OF A MARTIAN PALEDMAGNETIC FIELD

Bruce M. Cordell (Dept. of Physics, California State College, Bakarsfield, CA 93309)

A new mechanias for climatic charge on Mara involving interactions between the atmosphere and a hypothesised anoient planetary magnetic field is discussed. An early dynamo for Mara is compatible with current data on the martian interior, sodels of planet origin, and dynamo theory. The Jacobs/Busse coaling law suggests a martian dynamo field would have effectively chicked the atmosphere from the solar wind. Cooling and/or solidification of the core would cause dynamo extinction and expose the martian atmosphere to the full.

and expose the martian alsosphere to the full solar and galactic particle flux. These events may have triggered misor-phoric cooling and the present martian acc catastrophe. Climatic records of the Earth link depressed murface teap returnes with times of low field strength. It is maggarated that field disappearance may have led to log-induced mucleation (cloud formation),

SHORT AND INTERNEDIATE TERM RADON AMONALIES AS POSSIBLE EARTHQUARE PRECURSORS

Haukeson (Dept. Genl. Sei. and Lumbut-Boharty Geological Observatory of Columbia University, Palisades, NY 10984)

Paliases, W 10944)

The properties of 70 calon accasalies reported as pracurours to earthquakes in the U.S., U.S.S.R., China, Japan, and Icalsod are analysed.

The redon annualies occur at greeter spicontral distances for larger parthquakes agraceds. Ascasilies praceding large parthquakes (R 2 4) are frequently observed at a sincesse of 100 to 500 km. The time from the onset of an anomaly to the time of the asrbayake, the duration time, increases with magnicade but decreases with distance between spicester and radon station. In addition, radon anomalies are observed more frequently prior to large certhquakes than prior to small ones, indicating also that the preparation zone increases with aspaltade. The peak amplitude of a radon anomaly is not observed to depend an asrchquake magnitude, deration time, or epicentral distance. Therefore it is pranumed to depend on local cooditions such as type of reservoir rock or local hydrology. hydrology.

Thus the spatial distribution and the deration time of rates encoalies suggest that the properation some of the marthquake where precursors ofcur, expends with time evey from the prospective rupture some. A network of several radon stations expected 20-30 hm spert and located snywhere from one up to ten rupture dimensions away from the future epicenter, appears to be well suited to catch precursory radon anomalies associated with large earthquakes. MARTHQUARE SOURCE PARAMETERS AND SCALING LAVE

ALP 2

Ve approximate a dynamic theory of rupture in order to study the relationships between the static and dynamic seismic source parameters and their scaling laws. For small earthquakes, modelled as bounded circular ruptures, static attractionships and static attractionships between the dynamic attraction of the static attraction of the seismic attractions. For large awants, modelled as rectangular ruptures with one sign at the free surface, mean slip is proportional to dynamic attracts attract from in proportional to dynamic attracts attracts drop is proportional to dynamic attracts attracts drop is proportional to dynamic attracts at restant of the appet a since a constant between 1 and 10 bers for larger interplate earthquakes, and were alip and static attract drop increase linearly with fault length and separation, respectively. The theory sleep predicts the observed surface allp distribution observed on faults, and it is shown that all the static and dynamic source parameters can be derived from these observations. The assumption of constant static stress drop for large earthquakes is incorrect and leads to serious earers, as in the M, magnitude scale, which systematically underestimates the measure for the largest earthquakes.

S LIEA (INVITED PAPER)

ABOU METHOD FOR STATICS COMPUTATION

Coruh, C., Rogional Geophysics laboratory, V... Polyrechnic institute and State University, Dischaberg, VA 24001 Outsin, J. R., Beginnal Gouphysics Inboratory, VA. Folyicchnift Institute and State University, Blacksburg, VA 24001

The ABID statics recruitation action (Gorob, 1975) is bound on the use of seisuic retraction arrivals at adjacent excelver locations. The time difference of the refraction arrivals between two adjacent receivers from a noutce point is due to tracked path difference on the retractor and the static difference between tweetver points. The difference of the time difference of retraction arrivals at the adjacent receivers into points. In appoints directions can be determined. The static difference between two adjacent receiver points troubless determination of two terms. The first term is the time difference of the retraction arrivals which can be easily computed from the first breaks on the region on the region of the retraction arrivals which can be easily computed from the first breaks on the region. easily computed from the first breaks on the recorded. The second term is directly propertional to the cle-ation difference between the receiver points and tangent of the critical angle, and in-versely proportional to the value its of the

reflects.

The signbrate must the actor litrereness for all sizes parts with show rolatic starts are extended and contents and sizes which show rolatic starts are actor at more can be tied to actual static at the or must point a 10 obtain the actual static extrement.

function.

Define conventional reflection data, the APP is statice can be computed from the first broken, refine statice, the APCD rethod can be applied more than once on the same little. The rethod can be also applied on data on which field statics have already been applied.

S 116B CRAFTED PAPER)

EFFECT OF AUTOMATIC GAIN CONTROL SERVE CHOSS-CORRELATION ON RESOLUTION OF WIDE-BAND VIMPOSEIS

Coatain, J. K.. Pegiunal Geophysics Laboratory, Va. Polytechnic Institute and State University, Blacksburg, VA 24061 Coruh, C., Regional Geophysics Laboratory, Va. Polytechnic Institute and State University, Blacksburg, VA 24061

Multifeld (24-fold) reflection date were ecquired during 1980 on the Atlantic Coastal Plain near Portmouth, VA, using the VT1658 V18705119 (MDS-IC) system and Chebychev geophone arrays. Thickness of Cretaceous and younger selfcents here is approximately 300 to Seddments are relatively uncomposed ermits however, Single vibrator. uncompolitates assess on Cays and rest to the corphosed grante basecent. Single vibrator (Y-1100) sweeps of frequency content 100 hs to 20 Hs were used in an attempt to obtain data of relatively high resolution. It was found that application of digital sutomatic gain control application of digital automatic pain control to the field traces before tronscorrelation with the pilot swap resulted in a remarkable improvement in overall resolution and data quality of reflections originating from within the sedimentary section. Spectral analysis of traces before and after application of AGC shows good correlation but some whitening. The length of the AGC vindow daternines the degree of whitening.

S 199A

SIMILATED REFLECTED PRASES FROM ROUGH BOUNDARIES Pat Scott, Seismological Indoratory, California Institute of Technology, Passdens, CA 91125 Bonald V. Heisberger (same)

Donald V. Helmberger (esse)

The scattering of high frequency waves by 3-dimensional curved surfaces is lovestigated by massrically evaluating the Kirchbeff integral representation of the scalar wave equation. The Xirchbeff response is calculated by discretising the surface of a hessisphere, aposifying simple point sourcess on such element of the surface, and summing the contribution from the elements. The results of our method are compared to these of an asymptotic, first motion approximation of the analytical solution of 3H waves implining on a rigid aphers. The agreement between the results of the two methods is excellent for source and receiver distances which are large compared to the radius of the aphers. When the source and receiver are in the same place, we can demonstrate snalytically the squital sace of the two solutions. We also calculate trapponess caused by scattering from a hump or a spherical surface. The defocusing effects from tuch busps can be significant. We find that these effects are a function of the frequency cantend of the source pulse.

SA 53A

THE CROWTH AND DECAY OF HF-INDUCED PLASMA MAYES IN THE TOMOSPHERE

The recently completed HF [3-t2 Mir] (one-spheric heating facility near Arctico Observatory has been used to study the Lampural development of parametrically enhanced plasma waves in the Fregion. Experimentally, the Arctico 430 Mir radar was used to measure the growth rate of HF, induced plasma line enhancements over a time interval starting at the turn-on time of the MF electric field in the plasma and extending over time scales of many milliseconds. Plasma line rise times of several milliseconds were observed in the data. There was no evidence in support of rapid (\$10 usec) plasma wave growth rates. Thus, the presence of large amplitude plasma waves generated immediately at the copact of the

of size by linger supremium processes can be fulled but for Arcibbic therefore processes can be fulled but for the rise time casers times, the code time of the plants like emparationals such contents of the plants like emparations. These observations received her processes of law, excelled the processes of law, excelled the processes of law excelled the processes of law cartesians in the plants time decreased the supremium scales of one by the number of the second of the se

VIRALISMS, PRODUCEPING OF \mathbf{w}_{i}^{\prime} IN for exactly code was reported at FIGURE Angles.

T. Beren (Geophysical Institute, Colversit, of Alaska, Fairfaces, Alaska 90701)

My z. A. 8 vicrational population, in the datable migrating reflecting and sign altitude factor are evaluated using fireignostical areas and sign altitude factor and sign altitude for reflecting and injust considerations and injust considerations and injust considerations and injust considerations and injust on the electron injust on the sign and injust on the electron injust on the

The overcrist sectional data rules the greatural inferred in lifetine to the confidence by a factor of il to discliner to the sould be a factor of il to discliner to the sould be plus altitudes. And texting of the confidence of the date of the attention of

A. Cele Conffront, E35-15, 48-10-1015, 1967. 24. C. Ula 4 424 A. C. Pillon, IMP 16, 205.

1.0 R3A

THE COURSE ENGINEER LEADING THE STRUCK

- The lates fall and the way to be decreased by the late of the control of the cont

On Servicing Carnaci for yourse other on the circle fall annulation by distinct the gas term of the period of a form of the period and the circle of a form of the fall of the circle of a form of the circle of the

For profile positions, step in the time was not being an entropy of the profile Γ

to I hilliand chara Syr & Fisher and Inborators. Post late, on Postigh

country to the law long I am contend the match's characters several times, as present data from the LET I medium brings Particles from two LET I medium brings Particles from two with makes the existence of a do not in bour wrotable ask of a building ask for the open and the eight with each are the a particle took in the phase standard. A high wellout took in the phase standard and the death. A high wellotte took in the phase standard at the content of the eight of the phase conjunt of a tent of the took at the high energy tent of a tent of the phase of the phase with a minutentially do results high or took to the phase with a minutentially do results high or took to the phase with a minutentially do results high energy test. Several examples with the presented of the observed energytic perticle plants probable missions.

A BESTERN CONTINUES EXCEPANSE IN THE 8-74 MAY FOLL A PERMANEN ARE TANK E VALUES. The Paragraph of the E. Prierra (Francis) C. Hege Track of M. (2015)

N G. Fills (10 d. Saffred M. Olffit)

A file-rate of tells, as observation, 1963 to 1963, of the 8-25 May pratic population, as is 2.0, but shown a marginal decrease in this revisition of the state o rivalation force were aligned. This decay with different Edit Into and B co. until cov. At alfiel and acceptance.

We have described the same paratic problem for alient from 1972 to 1976, using experiments filter on an eral list stated little filt-1, 51-2, 51-3, 5

First through of the irest salisation some College Harden of the irest salisation some College Harden of the Patter of the Patte

Sa MA

MINES HE OF THE BOUNDS PEC TWO-FILLID SCEAR

Caras Sameers Repartment of Mathematics and Scatters, Memorial Latertains of Residual-land, in John's, Residualist, Alb 327 Canada

Piret prigram toward constituting a theorem(ral basis f. surferenceding the sofer wind can
sade be using one finit polyts pt bridge
(Parase, 1800), t.e., it was assumed that the
classical state of the secondary are good (effand bariefs by the state of the sofer are good (effand bariefs by the state of the sofer and derotes
the fort state of the state of the sofer and derotes
the sort surfercial gragers in and sevential
the sort surfercial gragers in and sevent
there was note by Newto and State of the country
of situations of the state of the state of the sevent desired placers and property and the sort of the
finite mention of the state of the sevent of the sevent desired of territor of the paper by Newton and
function is a network was based and make the sevent density. A bridg formal enclypts of the
origin polytopic translated and and the state of the
origin to this in a notively should make the
service to the state of the paper. It is
network that is an analyzed and and surface of the
origin to this in a notively should make the
service to the surface of the sort of the sort of the
origin to this in a notively should be sent of the
service that the surface of the state of the state of the
service of the sort of the sort of the
service of the sort of the sort of the
service of the sort of the sort of the
service of the sort of the sort of the
service of the sort of the sort of the
service of the sort of the sort of the
service of the sort of the sort of the
service of the sort of the sort of the
service of the sort of the sort of the
service of the sort of the sort of the
service of the sort of the
service of the sort of the sort of the
service of the so

COMMIZATION OF SOLAR WIND FLASHA PROPERTIES IN VILLED HELICHMARKET COMPONIATE SYSTEM

This tyr-Cu (Migh Altitude Ottervatory, Hitland Center for Attachheric Research, Boulder, CO

A. J. Pundhiusen (High Altitude Coservatory, hational Center for Atmosheric Pescerch. Parlder, (A. 80307) (Sponter: I. E. Holger)

In three directional structure of interplanetary reddure has been a topic of interest for a long time. In order to search for such a spatial structure, the organization of solar wind speed in a helicyraphic econdinate system has been in estigated using in situ observations, radio scintillations and creat tail observations, in limited nature of these observations and inconsistencies among the findings of earlier studies is we left sime doubt as in the existence of the heliographic latitude dependence of the wind speed.

speed

We have analysed the solar wind plasma properties as a sistial structure in a new coordinate system, which we call as helichagnetic condinate system, which we call as helichagnetic reordinate system, which when being color equation. Solar what append, proton temperature, and proton flow increase with helicongnitic laste de, while proton density decreases slowly. These variations are qualitatively consistent with those interpret from existing correct and in situ observations. chronel and in situ observations.

Dr. Zhan sue-fu is on Irave from the Depart-cont of Gonnhysics, Peking thriversity, Feking,

1 1251

WARFS OF ACCREMATED NOTION IN A CLASSES AFFROMING STAGE

Barrier hard (Division of Geological and Flancisty S. Senies, California Institute of Technology, Favelens, CA (1913) Horson Augelhardt (anne address) W. P. Barrison, Coopbrateal Institute, Valva atty of Alamba, Jashbush, AV (2013) (F. Maymond Coopbrates Program, Colombia

F. Form of troophysics Program, University of Washington, Seattle, MA 198(01)

falls to of drawthodly accolumned martin As it to of densitieably accollected ration, in which the they website in record subderly from atom 35 cords as 100-100 cords, and then destrains are until your the course of a day, ever reputedly during line and luly in Vicingsted of today in Probably surge soon. Those wals for the sufficiently in Probably surge soon. Those "officients of "may be related sechanistically to the technical unit surge. The acceleration in the websity programmates unsugaries as a long at a speed of about 500 m/hour. It is our resoled by a profighting pressure wave in the basis water system of the glatter. In which, alter a precentiony drop, the pressure rives capitly to a few igreator that she the state-builded pressure at the short-builded pressure at the short-builded pressure at the shorter bed, and then drop grobully eaching a new low for the augment. The peak velocity is an expanded by high exact, a finite due to fracturing that produce a notion and canche visitle in the glacier eachies it is also accompanied by a rapid uplied of the glacier surface, about the ten reliance over a period of 18-18 hours. These charterions can be explained and quantitatively by a physical model of the cycled pressure and novement vavor high exter pressure reduces bed friction and accelerates beard stiding, which couples with the high pressure to induce based cavitation; this increases the hydralic conductivity of the basid are, and the water pressure are propagates designates in the longitudinal conductivity gradient an established.

T 136A

LOWALIZED RAPHETIC PLEED VARIATION IN CENTRAL AND SOUTHERN CALIFORNIA 1974-1979

P. M. Cavia, M. J. S. Johnston and P. J. Maeller (Department of Farth & Space Sciences, Univer-alty of California, Los Angeles, Ca 95024) (Sponsor: David D. Jackson)

ispensor: David D. Jathani

The variations in daily averages of 17 difference field records between pairs of sagnatometers in the tile array has been analyzed for evidence of icosing i rajectic variation that high relate to stress changes on the San Andreas and Calculation and Theorems that can be attributed to respective and innespense activity are seen in 19 of the 17 and have been rescret sairty a linear ecobination of the component fields from Boulder Hawretic Chaerratory. The optimal coefficients are found for each pair, using multi-chancel (Wisner) predictive filtering. In a few class for which the coefficients are large, application of coefficients determined from bith frequency fluctuations has the effect of convecting the inquient drifts in the difference as to fit the secular variation trend for contrating and solution. Calculations has the effect are seen in three cases and can be removed using the prediction filtering, but otherwise such affects are seen in three cases and can be removed using the prediction filtering, but otherwise such effects are undetertable in the daily averages. The cleaned difference fields which result from removing fluctuations corresponding to iomospheric and magnatometers fields which result from removing the prediction filtering to presence of localized analysis of the two asynatometers closes to the entered of the two asynatometers closes to the epicearte, but the seconds for the Busch fault earthquake, 1974, have been identified in the seconds of the two asynatometers closes to the capital and temperatic charges of the romaining asynatic executation as all and the present of the capital and temperatic charges of the romaining asynatic executation and the contract of the capital and temperatic charges of the romaining asynatic executations as currently under investigation.

Additional And Revised Abstracts

USE INVITED

STHEFTS OF THE PLAMETERY PADIO ASTRONOMY OBSER-

H. D. Delch
J. T. Alexander
J. T. Alexander
J. T. Alexander
J. L. Sajaar (all at: PASA-Goddard Space Flight
Center, Planetary Magnatospheres Brench,
Grernbeit, ND 20771)
J. H. Varvitt
J. P. Pearcs
J. Evang (all at: Sadiophysics, Inc., Soulder,
CO 30301)
A. Leschert
J. N. Pederan,
G. Beigne (all at: Chservatotre de Paris,
Kaudon, France)

The Tujeger Planetary Redio Astronomy (Fib) lastrument has been recerting Astronomy (Fib) lastrument has been recerting Astronomy (Fib) action for the fiber of the Sistemann and the fiber of the Sistemann and the fiber of the

This strong longitudinal modulation of the radio edistion suggests the presence of an azimuthally asymmetric segmetts field slope Pioneer II accountments seem to rule out any aubitumial tilt of the magnetic axis to the planet's spin axis. Cruice observations also revealed that SKR is almost evolusively right-hand (AH) polarized (with some left-hand (LH) emission near 330° SLS) and that it generally occurs over with a spectral peak near 200 kis. The average isotropic power is about 10 matta-stronger than the terrestrial kitostric source but much weaker than the Jovian documeter and hectomater-

than the terreatrial kilocatric source but much weaker than the Jovian document and heatomater-wavelength emission.

The Saturn encounter data have revealed not only a wealth of detail concerning the SER but also low-fraquency plasma waves near Titan closest approach and at the outbound equator crossing. The smoounter also revealed the presence of short-duration broadband noise bursts at frequencies as high as the receiver limit of 40 MHz. Broadband, lightning-like emission of this nature has never before been observed by us with Voyager, and it is only seen in the close approach data.

We will overview the SER encounter results first. Several weeks before closest approach, the SER morphology became ours ecomplex. Although the ediasion still occurred preferentially near 60° SLS and the polarization sense was still predominantly HH, it became apparent that the SER was entaiting perhaps three distinct apported peaks instead of only the one peak near 200 kHz. A low-frequency component, with peak intensity below 100 kHz, also bended to occur at 60° SLS. At higher longitudes, near 200° SLS. a nuch higher-frequency component was observed with a spectral peak at and sorations above 500 kHz. This third component was never observed to extend above about 100 kHz. All three emission ecoponents exhalted the polarization.

observed to extend above about 1100 kHz. All three emission scaponents eshibited RH polerization.

Mear closect approach to Saturn, specifically when Yogager-1 (VI) was below the equator plane, the high frequency component began to deninate the emission spectrum. In addition, the polarization sense reversed to Lift or apposite to that which had been observed earlier. Although the apparent reached high negative latitudes at this time, suggesting interpretation of the emission in terms of a Southern-hemisphere accept, we find that a northern hemisphere interpretation may be now compelling. First, the gross surpnotesy of the emission does not change when VI passes below the equator plane. The emission appears the bane in dynamic spectra as it does before the polarization reversal. Second, the emission intensity does not follow an inverse-he-quared trend as it would for a northern-hemisphere source but now nearly as it should for a northeration of these waves away from the spacecraft if these sources are in the horthern hemisphere source. Finally, the diminution of the null part low-frequency conceants is consistent with refrection of these waves away from the spacecraft if these sources are in the horthern hemisphere. The LH polerization of the chission sight possibly be interpreted in terms of the wave vector encountering an appositely-directed magnetic field line and reverting interest and magnetic field line and reverting the polarized on before encounter. However, the preferred lungitude range of each is shifted. The shift of the low-frequency conceant is 135° in CLL, which is equal to the change in the Saturn local time of VI. We interpret this in terms of a cource which is fixed in local time.

The shift of the low-frequency component is 135% in SLS, which is equal to the change in the Saturn local time of Y. We interpret this in terms of a course which is fixed in local time, more like the terrestrial witcherit source, and which entry only were a preferred Saturn longitude coincides with a certain local time register. The components shift by considerably more than 135° (*180°) so the considerably more than 135° (*180°) so the source, and intitude register patterns requires more softisticated redsing which includes local time and latitude variations. In spite of the externily night situate of the cubound trajectory the three entasion components remain atrong and steady, reinforting their interpretation as forthern nemisphere sources.

When the spacecraft was within several weeks of encounter we observed phenomena remainiscent of the Jovian rails enission. For example, sectral arcs or parenthusis-shaped emission features in frequency-time spectrograms were observed. However, SKR spectral arcs are not rearly as common as the spectral arcs observed in the Jovian epission. In addition, the SKR accretines exhibits very rapidly drifting bursts at vitorater wavelengths. The drift rates are surprisingly uniform and equal to about 50 kightfunctures.

at vilorater warolengins. The drift rates are surprisingly uniform and equal to about 50 kHz/cin.

Of special interest are the about 50 kHz/cin.

Of special interest are the about 50 kHz/cin.

Of special interest are the about 50 kHz/cin.

Indoubtedly unrelated to the 3gs discussed thus far, these bursts appear randomly in time near clocast approach and randomly in frequency up to 30 kHz. We conclude that the bursts must be very broadband (tens of kHz) and of relativally short duration (>100 maso). High near clocast perpoach and randomly in sure that the sure finally resolution data show the radiation is assentially unpolerized and extremely intense. Thus it superficially resolution experience intense, in the planetial lightning intense. So, sithough the bursts could possibly be due to lightning in Saturn's standsphera, we are presently leading toward their interpretations as discharges in the planet's rings.

Fleams wave emission consenting the upper hybrid resonance emission observed by VI in the 10 torus was also observed in Saturn's equator plane mear the close approach to litam and near the outbound plane crossing. The plasma line observed near the outbound plane crossing consistent with cold plasma densities at and below about 20/ce.

Finally, although the possibility cannot entirely be ruled out until the V2 data are examined, we can find so evidence for freely-propagating radio smission from Titan.

U20 INVITED

F. L. Scarf (Space Sciences Dept., TAN Defense 6 Space Systems Group, Redondo Beach, Californis 20278) D. A. Gurnett W. S. Kurth (Boath at Dept. of Physics and Astronomy, University of Iowa, Iowa City, Iowa 52242)

The Voyager I plause wave instrument detected Intense and highly variable wave activity during the Saturn encounter. Strong low-frequency plasses wave turbulence was found in the wake of Tites, and we observed chorus, hiss, and half-gyrofrequency emissions with wave levels that pasted mear the butbound magnetic equator-ring plane crossing. Within the magnetosphere, we also detected electron plasma obciliations, the upper hybrid resonance emission; broadband electrostatic noise bursts, a number of discrete narrow-banded tonos, and strong inpulsive signals that has little dispersion.

EMERGETIC CHARGED PARTICLES IN SATURN'S MAGRETO-SPHERE: YOTAGER I RESILYS

R.E. Yogi, <u>D.L.</u> Chenette, A.C. Cummings, T.L. Gerrard, and E.C. Stone (California Institute of Ischnology, Pasadems, CA 91125) J.H. Frainer, <u>A.M. Schardi</u>, N. Lal, and F.B. HcDonald (Soddard Space Flight Center; Grenball, NO 2077).

In Contrast, to the Pinnear II encounter a year earlier, Voyages II transferd Saturn's agencia-sphere during relatively dulet interplanetary.

conditions. The fluxes of both electrons and protons increased rapidly at the inbound magnetopause crossing between 23 and 24 Saturn radii (Rg). Several peaks observed in the > 0.43 Mey proton flux just inside the magnetopause are interpreted as due to motions of the magnetopause. Yoyager I data have confirmed that > 1.8 Mey interplanetary protons can enter the magnetosphere to at least 10 Rs, presumably via the magnetosphere to at least 10 Rs, presumably via the magnetosphere to at least 10 Rs, presumably via the magnetosphere to at least 10 Rs, presumably via the magnetosphere to at least 10 Rs, presumably via the magnetotali. The maximum 0.5 NeV proton flux occurred maar 10 Rg rather than at 7 Rg as observed by Pioneer II. An asymmetry was observed between the inbound (~ 25° from the Saturn-Sun direction) and outbound (~ 150° - 170°) portions of the Voyager I trajectory such that comparable fluxes were observed at larger I. values along the inbound (subsolar) pass. The existence of a magnetotali was confirmed by soft electron and proton spectra beyond 15 Rs. Sporadic streaming of protons every frow Saturn was observed between 30 and 40 Rg outbound. Moon absorption features were found at the tabells of Itlan Rica, and fethys. In eshadom of Itlan was observed in equatorially confined protons near Itlan closest approach. Outbound, while Voyager I was ~ 7° above the equatorial plane, the spacecraft passed within 4° longitude downstroam of Rhra (L. P. R). A narrow assumption feature is interpreted as evidence for an outward distension of Saturn's magnetic field near the equator as may be produced by an equatorial ring current.

DIS INVITED

PRELIMINARY RESULTS FROM THE VOYAGER 1 HAGNETIC FIELDS INVESTIGATION AT SATURN

J. E. P. Comerney
R. P. Lepping (all at: MASA/Goddard Space Flight
Center, Laboratory for Extraterrestrial
Physics, Greeobelt, Naryland 2077)
F. M. Heubauer (Institute 6

Braumschweig, Federal Republic of Germany)

The results obtained by the Goddard Space Flight Center Hagnatic Fields Investigation ers presented. These results concern the large scale configuration of the Saturnian magnatosphere and small scale perturbations in the vicinity of the satellite Titen. The Saturnian magnatosphere appears more Earth-like than Jupiter-like in terms of its relative extent with the redius of the magnatopause at the stagnation point being approximately 23 Bg. There is evidence for a magnatic tail extending away from the planet on the nightside, formed by the solar wind-Saturn interaction. The tail disaster is approximately 80 Rg with so everage field of v3 nf at 25 Rg. The derived polar cap surgral zone has an 119-159 radius which makes it smaller then that of the Earth (18"). The intrinsic planetary magnatic field is primarily dispolar, as previously determined from the Pioneer it observations, and its polarity is opposite that of the Earth. The disple scale is a previously determined from the Pioneer it observations, and its preliminary analysis indicates a measur-scale tilt of 1.5 to 1.5°. The derived dipole offset is less than 0.05 Rg.

Voyager 1 ecountered the astellite Titan in the Saturnian outer magnetosphere (rather than in the solar wind) at 17 = 1330 with a clearst approach distance of \$\sime\$ 1.3 R\$. Significant perturbations in the ambient field were observed although there was no clear evidence for a bow shock or en intrinsic magnetic field. The corotating Saturnian magnetospheric plasms is deflected around Titan and induces a magnetospheric downstream as evidenced by a bipolar magnetic twil. The wake region and tail are, however, offsat with respect to the aspected corotation direction at Titan. The interaction phagneses suggest a parameter regime which is intermediate between that of the solar who-Venus interaction and that of the solar who-Venus interaction and that of to in the Joylan magnetosphere. interaction and that of Io in the solar wind-venus sphere. We conclude that there is no evidence at this time for a large conducting and convecting ore at Titan.

Geomagnetism and Paleomagnetism

ON MEASURING THE ELECTRICAL CONDUCTIVITY OF THE OCEANIC CRUST BY A MODIFIED MAGNETOMETRIC RESISTIVITY (MARJ METHOD¹

R. N. Edwards (University of Toronto, R. N. Edwards (University of horonto, Toronto, Ontario) L. K. Law (Pacific Goostlence Centro, Sidney, British Columbia), J. H. Delaurier (At asso address as Law)

Magnetotelluric sounding reveals a conductive zone beneath the Pacific Ocean at depths in excess of 60 km but does not resolve the conductivity of the lithosphere above this zone. Purther resolution can only be obtained by controlled source electrical methods. The simplest of these are the galvanic techniques. Schlumberger sounding is not suitable because current electrode asparations of thousands of Allometers are required. A visible alternative is to measure on the ocean floor the magnetic field of a vertical biple source. Magnetometer-transmitter apparations of only a few filemeters are sufficient to determine the conductivity of a half space. Magnetic field amplitudes are in the range of pice tesias for reasonable lithospheric conductivities and separations up to 10 times the length of the biopole. Modern instrumentation and signal processing techniques can detect such signals.

Oceanography

BOMB-PRODUCED RADIOCARBON IN SURFACE WATERS OF THE MORLD'S OCEANS AS SEEN IN ANOVAL CORAL RINGS Ellen M. Druffel (La Jolla Radiocarbon Laboratory, U.G.S.D., S-003, La Jolla, CA 92093)

Esdiocarbon measurements were performed on ring-dated coral samples that gree in surface water of the Atlantic (Rorida, Belias, Remil) and Pacific Geans (Sawaii, Galapagoe, Fanning, Canton Helands). These results represent the 18t levels in the dissolved inorganic carbon (BICC) present in the surface waters at the time of forestion. Pre-bosh 18t levels were determined for the older corals; the ANC values ranged from -75°/co (Galapagoe) to -51°/co (Florida end Beliae). Rediocarbon isvals rose to maximum ANC values that ranged from 125°/co to 186°/co. The pronounced differences between the ANC records for the different locations is satisface and near surface waters.

Planetology

cannot be explained by colestial machanics affects alone. It has been suggested that alestromagnetic affects are of consideral importance. Such affects are of two types; those working today, and those which were at work at commegonic those when the ring syste

was formed.

The repidly varying spoke structure is of the first type. According to a paper by Hill and Hamdie (1980), the spokes are formed by micron sized electrically charged grains levitated by electrostatic repulsion from the large-sized bodies in the riog, and concentrated by electric currents. The same paper also suggests a theory of the braided structure of the F-ring. theory of the bratese activities of the F-ring.
There is good reason to believe that the besic structure of the Saturnism rings derives from cosmogonic times. If electromagnetic forces are active today there is every reason to believe that they were also active at cosmogonic times (Alfvén & Arrhenius, 1976) These machanisms are discussed briefly. A detailed annilysis of the Voyager results is likely to discriminate between different cosmogonic theories

Hill, J.R & Pandis, D.A. (1980) On the braids and apobes in the Saturnian ring system (aubmitted to Astrophys. 5 Space Sci.).

Alfvém, H. and Arrheatus, G., 1970, <u>Evolution</u> of the Solar System, NASA SP-145.

Seismology

ANTSOTROPIC SYNTHETIC-SELSHOURANS IN INFLATED HOR

<u>Stuart Crampia</u> David C. Booth (both at Institute of Geological Sciences, Mutchison House, West Mains Road, Edinburgh, EH9-3LA, Scotland, U.K.!

Correct interpretation of selsmograms of acoustic swants in hydrofractural reservoirs appears to be the only way to resolve details of the crack geometry and monitor drack growth. Sydrofracturing at the BDR experiment at Los Alamos, at one stage, appears to have opened a classic system of large parallel vertical cracks enclosing a slab of small aspect-ratio which subsequent cooling cade effectivally anisotropic by opening cracks perpendicular to the faces of the major cracks. Such effective anisotrophy can be modelled by an elastic tener which displays the same velocity (ani attenuation) variations as the cracked solid. Synthetic selsmograms through such an inflated structure are calculated by modifying the reflectivity technique to accept anisotropic layers. Correct interpretation of selemograms of

Syers.
At the perticular stage of the LASE MER experi-At the perticular stage of the LASL HER expericent we are modelling downwell three-component
geophone record seismograms showing many combinations of two basic seismograms with several uncasel features. Our (very preliminary) modelling
produces synthatic seismograms with these same
features, and domonstrates that the large variety
of observed seismograms is caused by the relative
positions of the geophone and acoustic swent with
respect to the major cracks.

It sppears that, if the growth of a reservoir is
always monitored with downwell three-component
yeophone, it should be possible to interpret the
records, with the sid of synthatic seismograms,
in terms of the geometry, orientation, and
dimensions of the major cracks, and the crack
density of the contraction cracks.

PREMOVITURY CLUSTERING OF EARTHQUARES (CLOBAL TEST AND POSSIBLE MODEL)

V. Kailis-Borok (Institute of the Physics of the Earth, Ac. Sci. USRR, Moscow, USSR)

Twenty out of thirty-one atrongest earth-quakes in fourcesn regions of the world are preceded by the bursts of aftershocks or other clusters within three years. Twenty-four of thirty-one clusters are followed by atrong arthquakes within three years. However, 531 confidence level cannot be claimed yet, since two following thresholds were dete-fitted in each region: the winimed number of earthquakes in abnormal clusters; the

magnitude, above which the sarthquake is con-sidered as strong. Three bursts of after-shocks occured after these thresholds were established and were followed by a strong

earthquake.

Possible model of presonitory clustering is an expanding crack with dynamic friction depending on the slip-rate A and dynamic coheston depending on the welloutly of the crack expandion //dhonormal clusters appear in such model under following conditions: shear strass is large; friction rapidly increases with A; cohesion rapidly increases with A; cohes

SPR: Aeronomy

S DAULTANEOUS MEASUREMENTS OF ION DRITTS AND MEUTRAL WINDS USING INCOMPRENT SCATTER AND FARST-PEROT INTERPEROMETER TECHNIQUES

R. Schuke (NAIC, Aregibo Puerto Rico 00612) R. C. Burtuside and V. A. Harrero (Dept. of Fhysics, University of Fourto Rico, Eio Fladras, F. R. 00931)

Elevations measurements of P-region ion drifts and neutral winds have been carried out successfully for the first time. Ton drifts were beasured with the first time. Ton drifts were beasured with the first time. Ton drifts were beasured with the first time states reader using a beamswing technique by which the for valocity is decomposed into components parallel and parpeadicular to the megnatic field lines. Neutral winds were measured with the Fabry-Farol interferometer measuring the Doppler entited 530% emission line, using a stallar heamswing technique to obtain both meridional and somel wind components. A comparison of the somel ion drift with the somel meutral wind shows that both ions and neutral wind shows that both ions and neutral wind shows to come the result of Eng drift, our results suggest that this ion drift is due almost entirely to polarization electric fields set up by the gomel neutral wind. It is shown that this is a vary important mechanism for Aracibo. A comparison of low drift along the field lines with the sortidional neutral wind allows a direct measurement of the diffusion velocity assually yield reasonable results, there are some ascoptions.

SPR: Magnetospheric Physics

CAN COLLISIONS INHIBIT FIELD RE-CONNECTIONS

A. Sciaccaluga (Department of Physics, University of California, Sen Diego, La Jolla, CA 92093 Sponsor: Eldon Whipple)

An analysis is given of the effects on the collisionless tearing mode of a small collision frequency. The Lorentz collision operator is handled by a Langer transform for a simple slab geometry, and it is shown that a small collision frequency inhibits the growth of the instability.

KELVIM HELMKOLTZ INSTABILITIES AND LONGITUDINAL ELECTRIC FIELDS

W. B. Thompson (Department of Physics, University of California, San Diego, La Jolla, CA 9203 (Sponsor: Eldom Whipple)

The origin of longitudinal electric fields (i.e. parallel to the magnetic field) is sought in limited regions of high transverse shear. Polerization fields are nautralized by longitudinal currents which both limit the shear and require driving fields. As a specific example finite length effect on the Kelyin Helmholtz instability is analysed using the small Larmor

radius expansion. The saturation of parallel currents and the possible formation of local-ized potential steps is also considered.

AURORAL ARES: BOUNDARIES BETWEEN MAGNETIC FLUX TUBES

6. Atkinson (Mationa) Research Council of Canada, Ottawa, Ontario XIA 086)

A new theory of the macroscopic conditions for sureral arcs to form is proposed. It is suggested that arcs may form where the topology of the magnetosphere requires different magnetized plasmas to be adjacent, or where the time history of the first has produced be adjacent magnetized plasmas. Under these conditions an arc will form at the boundary between the two plasmas if a sufficiently intense upvart-directed current is required by the difference in magnetic fields across the boundary. The boundary is a tangential discontinuity in the magnetized plasma. An arc is therefore expected at the boundary arc is therefore expected at the boundary between summard and anti-summard flows on the avening side, at boundaries between open and closed field lines which appliants quiet time polar cap sun-aligned arcs, and at boundaries between plasmas which have merged on the dayside or reconnected on the nightside in different impulsive events. The last accounts for perallel arcs within the oval and for arcs occurring near the throat at active times.

${\rm Be}^{++}$ emeals embyes associated with sudden convenients at geostationary crait

M. Martinie (Mar-Flanck-Institut für Aeronomie D-3411 Katlenburg-Linden 3, FRG) (Sponsor: A. Richter)

With the ion composition experiment on Geom 2 that seems on the equatorial plane the mass-sargy spectra for energies per charge 4 16 keV/s it is found 8s exhausements of short lived duration (several hours) seeming with interplanration (several hours) associated with interplan-etery space shocks eviden compensments. During the event observations the He fluxes reach up to 2-10 of the H fluxes and are located in the dewn-midnight sentor. The origin of this pusks can be identified with playes sheet injections at its inner boundary, in the dush-midnight sentor from which the He element drifted into the geo-stationary settlite. The shorter life times of the He , squaret charge exchange, compared to He , se well as the variability of concentrations of sliphs particles in the solar wind makes of siphs particles in the soler wind makes the He is good tracer of interplanetary plasma in-

SS: Solar and Interplanetary Physics

9. Scholer (Mostland Invitates, Carching, 1984) forming 20th;

5. Trivial department of Physics, Diviers Six of Mireland, college Park, Maryland 2012), to observe the private of Physics and Attenders, Diviers Programmed Attenders, Diviers Programmed 2012), a Diviers of Six observed 1800 obligators as Scholer).

offer relatively Aromous offers of the particles in the upstrong constitution at 1811-18 the particles can expend that construction. The proton information that the text than at 1811-1 at 30 keV, the spectra at

ISM -1 are stooper than the spectra at ISM -1. Flux ratios and spectra are discussed in turns of a first order term acceleration godol with a diffusion coefficient in reasing about linearly with energy and a free escape boundary at wore distance operates.

0274 PEVISED

Do-10 MEASUREMENT IN MARIKE SAMPLES BY ACCELERATOR HARS SPECTECHETRY

A. Hanglai¹, J.H. Thomas², J.R. Cochras¹, P.D. Parkor², F.K. Turokkim²(I: Dapt. of Geology & Geophysics, 2: Wright Hutlear Structure Leb., Yale University, New Eaven, CT 06530) and P. Shetma and S. Krishnamusai (Physical Basarch Leb., Navrangpura, Ahmodabad 380009, Indie)

Lab., Navrangpura, Ahmedabad JB0009, Endia)

At the Tele tandom accelerator measurement of Ba-10/Ba-9 ration of 10 12 with ± 10% to arror has been achieved with an improved geometry in the cealum aputer source using only 2-6 mg of Ba-9 oxide carrier. GEOSECS N. Pacific station 100 deep water has a Ba-10 concentration of 6100-1200 atoms/g based on our distance Ba-10/Ba-9 standards made from a callbrated Ba-10/Ba-9 station the surface vater values reported mariliar by Enisbeck et al, and yield a mean residence time of shout 2000 years for Be in see water. Two modules, one from the N. Pacific CP, 151°W) and one from the indian Ocean (76°S,108°E), each sampled to a depth of shout 1 cm have Ba-10 growth rates of 1.8 and 2.2 mm/sy respectively. The Pacific Ba-10 rate is about a factor of 2-3 smaller than the Th-230 rate, whereas for the indian Ocean it is higher by about a factor of 12. The attrapolated Ba-10/Ba-9 ratio for the Pacifit module is about 1x1016 atoms/g Ba. If the initial Ba-10/Ba-9 ratio for the Pacifit module is about ix1016 atoms/g Ba. If the initial Ba-10/Ba-9 ratio for the measured Ba-10 concentration in see water yields a Ba-9 concentration of about 0.6 mg/kg comparable to the direct determinations reported by Merrill et al in 1860.

V 14th (REVISED)

ALROSOF PARTICLE SIZE FRACTION AND TRACT GAS SAMPLING OF VOLCARITY PROBES BY CAS CADE, DIFFALTOR AND TRIBATED FILTERS BY A RUBOTE-CONTROLLED ATBURAGE

Renand VIC 1. Sign Jean-Paul Quinefil (both at Liberatolic de Chinte Minérale, Briversité Paras 7, 75005 Prits, Francel René Exivic-Pierret (dlA, centre d'Ernder, Autébures, VSOII Grandele, Francel Daniel Narth (dlPf, tentre de Recherches Atmosphériques de Highy-les-Hancale, 78170 St. Pény les (becreuse, France) Highael Barta

Michael Barra Alistair 77.0. Le lie (both it Department of Oceanography, Florida State Univer-vite, till that wee, H. A. 1004

A six tage ringle erritice at old in partor and treated gas theothing riller, have been those by a remote controlled iteration the plane of the time. For the tent in the plane of the time in the filler with the filler with the plane of the time in the filler with the plane of the time in the filler with the plane of the time of a filler. I do not the filler with the filler with the filler with the filler with the filler of the fill of the filler of the filler

GAP

Separates . . . a great value!

Print quality reprints of individual articles from AGU journals

are available at a nominal cost to you! To Order: The order number can be found at the end of each abstract; use all digits when ordering.

Cost: \$3.50 for the first article and \$1.00 for each additional article in the same order. Payment must accompany order. Deposit Account: A minimum of \$10.00 may be placed on deposit with AGU for the purchase of separates. If funds are on deposit, the cost of the first

article is only \$2.00 and \$1.00 for each additional article in the same Separates will be mailed within 3 weeks of journal publication or within 10 days if ordered after the journal has appeared. Separates are available for

purchase for two years from date of publication. Articles from Reviews of Geophysics and Space Physics are available for all year when ordering. These articles are excellent for classroom use

Copies of English translations of articles from Russian translation journals are available either in unedited form at the time of their listing in EOS or in final printed form when a journal is published. The charge is \$2.00 per Russian page.

Send your order to: American Geophysical Union 2000 Florida Avenue, N.W. Washington, D.C. 20009

Geodesy and Gravity

1965 Artificial satellite techniques
A COMPARATIVE ANALYSES OF OPS RANGE, DOPPLER AND INTER PEROMETRIC OBSERVATIONS FOR
GEODETIC POSITIONING
Patrick Poli (Mayal Surface Wespons Center, Dabligren,
Virginia 29448)

Patrick Full Givel Surface Weapons Center, Dahlgren, Patrick Full Givel Surface Weapons Center, Dahlgren, Virginia 23445)
Geodetic positioning accuracies obtained from range, begrated Doppler and double differenced interfavoursely-four Global Positioning System satellities are Presented, it is demonstrated that GPS range and Doppler observations will provide sufficient accuracy for the selimation of geodetic coordinates, Howaver instability of the receiver-should pacific to will instability of the receiver-should pacific to will mad first other baselines of these observations in providing matric phase measurements twice differenced to elimproviding story appears as an alternate procedure for Royalita Geodesicus. Defiding such accuracion.

Asita Geodesique, Vol. 64, No. 4

1905 Artificial satalita techniques
ACURREY OF MEAN EARTH ELLIPSOID BASED ON DOPPLER;
LASER AND ALTIMETER OBSERVATIONS
Richard J. Anderla (Maval Surface Meapons Center,
Dahlgren, Virginia 22448)
The error in the mean earth ellipsoid computed on
the basis of Doppler or laner observations of artificial earth satellites or rader altimater observations of the ocean surface from a satellite depends
upon instrument prequision, on uscurtainties in the
specification of the earth's gravity field at both
long and short wave lengths, on uscartainties in
the origin of the coordinate system, on modeling
errors in ionospheric (except laser) and tropospheric
refraction, and, for altimetry, on co-anographic
effacts. The magnitude of the uncertainty in the
computed ellipsoid will vary depanding on the size
of these errors and on the number and distribution
of observation stations. Review of computations
besed on various data sats indicates that differences
in the computed ellipsoids are consistent with those
expected due to the various error sources and that
the best fitting ellipsoid, has a semi-major axis of.
637615652 m.

Izvestiya Atmospheric and Oceanic Physics Volume 15, Number 12, 1979

CONTENTS

Granberg I. G. Numerical Simulation of the Problem of Mountain Streaming by the Air Flow

Fushistov P. Yu., Shlychkov V. A. On Interaction of the Middle-Scale Perturbation of the Boundary Layer and Free Atmosphere

Kozlov V. P., Timoleev Yu. M. On the Optimal Conditions of Outgoing Radiation Measurements in the CO. Absorption Bunds and the Accuracy of the Thermal Atmospheric Sounding Method

Egorov S. T., Plushchev V. A., Viesov A. A., Morozov V. F. Satellite Mapping of the Earth Surface by Its Natural O.8 cm Radiation

Sanickhvalov I. V. Lidar Equation for Inhomogeneous Atmosphere in Double Scat-

loring Approximation .

Rosenberg G. V. On the Nature of Aerosol Absorption in the Short Wave Region of Spectrum

Lappo S. S., Rozhdesivensky A. E. On Computation of Energy Transmitted from the Atmosphere to a Moving Meteorological Tide

Kochergla V. P., Sheherbakov A. V. On the Influence of Wind on the Large-Scale Ocean Currents

Ocean Currents . 1300 Petukhov Yu. V., Fridman V. E. Propagation of Blast Waves in a Stratified Ocean 1307 XOTER

Kilay Sh. D., Naumov A. P., Sumin M. I. On the Determination of Pressure and Geopolential by Results of Radiothermal Sounding of the Atmosphere at A=5 mm

Gadizov A. G., Stepanov A. S. On Derivation of Condensation Equations for Turbulized Cloud Medium

1318

PERSONALIA

Professor Balabucy Analoly Georgievich (To 90th Birthday)
On the Contribution by Prof. P. A. Sheppard into Development of Atmospheric and Oceanic Physics

1325 CRITICS AND RIBLIOGRAPHY Shmeter S. M. Pook Review: Rogers R. R. & Short Course in Cloud Physics (Gidrometeolzdat, Leningrad, 1979)

Mazio I. P., Khrgian A. Kh. Book Royew: Rogers R. R., Vali Garbor & Recent Developments in Meteorological Physics (Physics Reports, 48, No. 2, 65-117, 1978, North-Holland Publ. Co.)

CHRONICLE Ozmidov R. V., Fedorov K. N. Turbulence in the Ocean (Materials of 11th Inter-national Liège Colloquium on Geophysical Hydrodynamics and of 2nd Inter-national Symposium on Oceanic Turbulence, Liège, Belgium, 7—48 May 1979)

index, 1979
Correction to the Paper by V. I. Smirney and B. N. Sergeev (Izvestia of Academy of Sciences, USSR, Almospheric and Oceanic Physics, 15, No. 5, 1979)

1334

Gerraria, and E.C. Interest of Institute
of Inchanlogy, Pandena, CA 97125
JH. Irainer A.M. Schurit, N. Lai, and F.B.
HcDonaid (Soddard Space Flight Center;

Branchill, NO 2077)

In tourist to the Pinner il encounter a year maker to represent the contract of Electrical Engineer and Space Flight Center;

In tourist to the Pinner il encounter a year maker to represent the contract of Electrical Engineer and Contract for American Engineer and Engi 6378196±2 m. Bu) letin Geodesique, Yol. 54, No. 4

N

-

NEW from AGU

GEODYNAMICS SERIES

final Reports of the international Geodynamics Project published with the Geological Society of America

The Series:

Indicidentalisated Goodspaceles Project, 1970-1979, he indicated to sellong the ingstates of the dynamics and dynamics tustory of the oratin Papers resolves the resolvest of the control treating the scientific are uty and actional standards of this series of state of the oil reviews can be

 Give specialists an opportunity to evaluate. progression metricular of resporch

uwo sturients an efficient method to retrieve

reviewed, and another concept, called the reconstructe thanks method, to described in none detail. This concept to being pursued by the Pelense Mapping Agency, National Oceanic and Atmospheric Administration, and the U.S. Geological Survey. These

agencies have numerous repairments for accurate positioning. Several productor receivers are planned to be destiable for testing in mbs 1992. These receivers

should be highly portable, consume little power, and obtain base line accuracies of several centimeters in

common rose the absuractes of several restinators in several bours of observation time, these experiments while to mended in errier to achieve the fall occuracy, but of simulation results utilizing the reconstructed carrier phases results are included, [billouis 15 absurption, 5.1, 71, 8.1, 4]

ISON Femetric Chievations and methods

EFFCENTIONS OF CONCETTO AFFECENT IN GRAVITY INVARIANT AND PRICEITIAL LIVERINGS REPORDENTATIONS

Ecoard Usa's limit of Geodesy & Applied Math., ul.

Enumentials 5, 50 357 Nordine, Folded)

The analysis of deferrations and reductions of the
Concett retweets in general gravity treations and
Concett retweets in general gravity treations of the
Concett gravity and content of the first particles of the
Conferrations of any interest formulae of the
Conferrations of the first described in the conferrations

Conferrations of the first described in the conferration

Conferrations of the conferration of the conferratio

1939 Corneted observations and methods FEGUND ORDER DESIGN OF A FIRE DISTANCE NEUTRARIA, CONSIDERING DIFFERENT TYPES OF

Engineericate 7, D-7500 Karlarshe, W. German):
A numerically efficient solution attempt is developed for the second order design of a free distance network. It is based to the fact that the direct (moncancelled) way has a regular least-squares solution.
A flow that tilinatures the direct construction of the
final equations, using a list of point coordinates and
a list of projected distances as imput. Results are
shown for an exact network of points. At distances,
considering different types of criterian matrices:
Tailor-Kurtian structure with homogeneous-twittopic
public error ellipses and special Taylor-Karmas strucaire withinstructive relative error ellipses. Findity, the
criterion of a criterian matrix up is briefly discaused in the case that a certain universe of quantities
shall be desired from the nervort.

1964) BLUM, AND VERTILISME PETERMINATE OF FROM PREQUENCY VARIATIONS IN EARTH 5 TO TATED STRUM POPPLER SATELLITE CHARLES OF THE STRUM

B.J. Andorio & C. Centeretes Clarat Surface Wesp.

one i enter, Dalgren, Virginia. 22(4).

The determination of high frequency estations in UT-1 and a component of puls position from a single pass of Deplet characterists of a Many Navigation Safel its is affected by tentropeent arrors and one establish in the gravity field and atmosphatic drag force a used in computing the auxiliar cebit. For elements a larger above 20, instrument errors contribute plant in the determination of UT-1 and 142 to the determination of DT-1 and 142 to the determination of DT-1 and 142.

to the determination of pole position, tirarily and drag earners contribute about 6,73 of correlated error, but of complete right dust assess and sequest pe testions formula extend and po jupited pic setting a testions durant commence amont also be conserved a testions

of residents ther drag arrors are reduced by free groupstating the tree should fedure be welling the cold and the processing the tree so the place of the cold and the processing of 12-1 and the public cold and the processing of 12-1 and the public cold and the processing of 0.8 meet

per per percent could achieve precisions of 0.8 meet and 100°, supportively, accoming out the passes out-transe in the determination of each component of pur-position. The correct accounty of inapples results for two day societies is a short 50 cm for pote porition and i make the high trappasses variations in UT-3.

· 100-11

Featur, Dabigras, Virginia 22(4)

shall be derived from the servert, Bulletin Confestion, bel. 16, 16, 16, 1

CRITERION MATRICES

give scientists in either disciplines an everview of the scientific progress of the intervational Coodynamics Project

Dynamics of Plate Interiors A W. Bally P. L. Bender, T. P. McGelchin
16. I. Walcoll, editors
Brings logether the skills of geophysicists, geodesists,
(jeologists and geomorphologists—earth scientist of
a wido variety of disciplines and lockniques to communicate the significance and relevance of their individual research to each other and to those of divergent fields of study. The areas explored are.

ISBN 0-87590-508-0

 dynamics of picte interiors from the stratigraphic Mode and mechanisms of plateau uplits glacial isotiasy

present crustal movements and instrumental observations

168 pages List Price \$15.00 AGU members are enlitted to a 20% discount

American Geophysical Union 2000 Fiorida Avenue, N.W. Washington D.C. 20009 inguitios caratistarelling order: halfus serius ara welcomo

VIII.

toos Actificial mainlike techniques Using the Gladral, respected system (Glis) for Geodetic Instrument 1990 Instruments and techniques
A FILL-IN STORAGE TECHNIQUE REG GRODETIC A FIL-ON STORAGE TACHNIQUE Non GEODATIC NORMAL AQUATUMS
P.A. Cross (Papl. of Land Surveying, North East London Polytechnic, London Et? 43h)
A minimum fill-in scheme, published by Yale libractive and not previously discussed in the geodetic literature, has been tested on four typical triangulation networks. Its computer storage requirement has been compared with that of the profile mathod using May's station reordering algorithm. These have been carried out for townstall and mixed terrestrictly satellite networks.

The conclusion is that the fill-in scheme in a viable John Bessier & Civin Good (Plattical Cochetic Servey, New, MAAA, Rockwille, Marviand 20953) The development of relatively inexpensive satellitie receives in the ently 1870's has resulted in contreceives in the saily 1870's has resulted in cons-effection applications of saintlines for a surface of geodatic surveying meets, thereafty a histories ar-curation range from 10 to 30 centimeters. The NANATA (dotal Positioning System, now under de-velopment by the Peptitment of thefense, incorporates at mored technology which has the p-kential capability of mandetioning antilitie geodesy. Haveral concepts for utilizing title signate are briefly restanced, and another concepts and of the respectively.

The conclusion is that the fill-in scheme is a viable method for geodetic networks and, in some cases, it needs less computer storage than the profile method, Bulletin Geodesian, Vol. 54, No. 4

1970 Capdasy tostroments and techniques
TOSSIBLE THIT PHEMOMENA OBSERVED AS MATER LEVEL
ANYMALIES ALONG THE LOS ANGLES APPENDED
Poter C. leary, Fater E. Nalin, Richard A.
Scotlins, and thomas I. Hauyey (Repartment of
techniqueal Sciences, Christman Appeller
telliterial, Los Angeles, California 90007)
Mater levels to the Los Angeles Appelled in
nutrees California fluctuate in a numer that are
not easily attributable to normal squadurt operarions. Simple hadronics suggests that large scale
earth ritt can register as writer level ancomalies
with a semplication of thost level ancomalies
with a constitute of thost 100 ft/fulcoredian.
The appendixt numbiles which coincide spatially
and temporally with independently observed deformalives of phemomentary used to explain this suggestion.

Saphya, Res. Latt., Paper 110128

Hydrology

3115 Evaporation
ESTIMATING EVAPORANSPIRATION FROM THE SOMOITA
CREEK WATER SWED NEAR PATAGONIA ARIZONA
J. Ben-Asher (The Jacob Blaustein Institute for
Cesert Research and Department of Biology, BenGurion University of the Negev. Beer Sheva,
12-2211.

Surion interestly of the Neger, Beer Sheve, Israell.

In a study that was proposed to evaluate the water belance of the Sonoits Creek watershed near Juson, Arizona, monthly evapotranspiration was defined by Morton's conceptual approach for large area. The objective of this study was to test the model. The suriable climatological data were solar radiation, dev point temperature, seen scantily temperature and humidity.

The model was evaluated by tasking the relationship between potential and actural evapotranspiration in Africa. Data were taken from the Atlas of the World Mater Belance and found to be in agreement with the concept of a conglementary relationship. When applied to a small matershed such as Sonoite Creek, the model performance was good on an annual besis and in the hot seasons, in the cold seasons, however, an alternative approach eas used. Every swiysts indicated that a major source of error lies in the fact that the model neglects the effect of surface moisture content on net radiation. It assumes a single value of net vadiation for both Priestley-Taylor and ferman's formula. Mowers, the assumption of a unil-matered surface, which is inherest in the first formula, must be associated with met radiation which is higher than that associated with Formula's formula. As a result, a maximum error at lation which is higher than that associated with Formula's formula. As a result, a maximum error at lation when the season of the annual supportanspiration. ation cu, occur. Vater Pespur, Res., Paper 190085

Also de la Samer Alsona, para la la la Algoria de Albredo.

The first state of the second state of second se

II TO Graundwater COMPARISON OF LABORATORY, IN SITU, AND ROCY MASS MEASUMEMENTS OF THE HYDRAULIC COMDUCTIVITY OF METAMORPHIC ROCK AT THE SAVAKNAP PIVER PLANT MEAR AILFN, SOUTH CAROLINAP

1. Nondel's Natine CE. I. du Pont de Nemoure & Co., Savannah River Laboratory, Alkon, South Carolina 2000

Albri, SOUTH CAB-LINA"

1. Non-bell Namine CE. 1. du Pont de Namoura à Co., Savannah River Laboratory, Alken, South Carolina 19808

10 Silv testing of emploratory wells in matworphic rock indicates that two types of fracturing occur in the rock seas. Nock containing email openings that peroit only extremely slow movement of water is termed virtually impermedite rock. Nock containing apenings of sufficient size to permit transmission of water ar a significantly faster rate is termed wylvaulically transmissive rock. Laboratory methods are unsuitable for meaning hydraulic conductivity in hydraulically transmissive rock. Laboratory methods are unsuitable for meaning hydraulic except the hydraulic productivity of the rock mass over a large region is calculated by using the hydraulic gradient, porosity, and regional velocity. This velocity is determined by dividing the interest travel distance by the age of water which is determined by the hellum content of the water. This rock mass hydraulic conductivity value is between the values measured for the two types of fractures, but is closer to the measured value for the virtually impermeable rock. This relationship is attributed to the control of the regional flow rate by the virtually impermeable rock where the discrete fractures do not form a continuous open connection through the entire rock mass, thought for the virtually impermeable track where the discrete fractures do not form a continuous open connection through the entire rock mass. Thus, laboratory methods of weasuring permeablity in methorophic rock are of value if they are proporty applied.

3160 Remotf and attrameling conditional Flow Simulation: A STOCHASTIC FORE-John P. Zuset (Columbia Platesu Conservation Re-search Center, P.S. Sox 370, Pendieton, Oregon

Vater Resour. Res., Paper 80/1833

John F. Zugel (Columbia Plateau Conservation Research Center, F.O. Sox 370, Pendleton, Oregon
97301)

The formulation, verification and application
of a stochastic conditional flow elemination (CFS)
much is distumma. The much) uses most water
equivatent values from a monoverse site as input and generates probability distributions of
ancw vater equivalent values for succeeding
months at the snowcourse site in addition to
southly and longer-term flow volume distributions.
The CFS model requives no basin calibration,
little computer-core storage, and short vun tissa
and forecasts cruly stochastic snow water equivalent and flow volume. The model also preserves
the historically observed stockeric rane water equivalent snowcourse site and flow volume, as well as
the snowcourse site and flow volume, as well as
the intermenthly relationships for each variable.
The results obtained in actual flow volume
forecasting elemetics indicated that this model
has the potential of becoming an operational flow
volume forecasting tool. (Flow volume forecasting, modeling, similation, movement runoff).
Water Resour. Res., Yaper 190192

wolfenante tan Francis wiff SVALUATION OF CHORT STRIPT OF DISCHARGE TO A UNITARY VICE BY POINTS OF LONG RECORDS OF WATER 1-WE DATERAL.

The French: Journathers Basson and Guy Rédict
Research Instrumente de Basson Sean Regrandie,
10-1: run du Capitaine-Pinard, 1912 Paris,
Language

Vater Resour. Res., Paper 1W0192

indicate de Empais Scane Regrandie, Indicate de Empais Scane Regrandie, Indicate de Capitanne-l'inari, 1992 Faris, Scane)
Fainfail deptie and mater levels in rivers have then eyeteratically recorded in France nince the dillio of the mineteenth century. These long described in records can be used for completing four records of discharges of rivers on plains. The treatment of a long norther must first be writted and the reliability of the double mass while death of the discharges at a site proposed for the found daily discharge at a site proposed for the available long standing data record. The generated series are firectly usable to work out the dimensions of storage and filed control reference and to describe real time forecasting matter death is negligible compared with the cost of the investments for which they will be used. (Record extension discharge)
Hydrological Sciences bull, vol. 20, no. 1.

Meteorology

370% Air quality A CASE STLDY RELATING HIGH GROUND LEVEL GRONE TO CHARGED PROTOCHELISTRY AND SECURETO TRANSPORT FICE DE STRATOSPERE F. L. Bragenson, N. A. Shapiro, F. Hiddleton Chattonal Center for Autospheric Research, F. D. 4 v. 1009, Boulder, Colorado F0307), A. R.

Lited
Exceptionally high orone ground level concentrations (200 ppb) observed in Denver, Colorado on the afternoon of March 4, 1978 are explained to terms of enhanced photochambetry combined with tearnoon property of complete the to terms of anhinced photochamietry combined with iseastoph. Transport of caous from the stratesphere. The existence ownse concentrations observed on there is existence of the local pollutant and coreordogical data above high early royning accumulation of precursor games and sobsend potential for aftermone photochemical activity. Objective cross-sectional scalaries that cheed this content of the tendary layer over the city on the afternoon of March & work darlyed from a strate-spheric intrusion three days earlier. It is consided that a combination of these factors resulted in the exceptionally high exons concurrently. trations. J. Geoghya. Res., Green, Paper 100099

3710 Roundary layer structures and processes PLANE WITH PROTENSIONS AS AN ATMOSPHERIC ROUNDARY

PLARE WITH PREPERDITIONS AS AN ATMOSPHERIC BORNMARY
J. Otterman (ral Aviv bitwaraity, Samet Aviv,
Isran)
A plane with protrusions in analyses as a model
for results sensing of the Earth's authons and for
absorption of salar irrediance at the surface of
the model is aimed at representing the surface of
aris' regions where plants form isolated clumps
with large interactions of bara sell. Applicability to wher the train types, such as attable
fields, tundra and bereanah appears possible.
The protrumions (plants) are regarded as thin
warties! sylinders and the key patenter, s, is
the sum of hight-time-diameter weducts over a
unit area, Samete sensing from a sun-synchronous
entallife (Londant) indicates the piresthility of
the model, incoment as in least-onen-quares
fit the model closely reproduces, as a function
of the color winth regio, the reliceityties
to senith measured by Landact over an axid
atappe. The explicit supressions for the homispheric vellectivities indicate a pressumend
change in the purface sibedo, as a function of
the color winth region of terrain described by such
a model. The solar heating of the pretrusions
constitutes an important component of the nouface heating when the new is alone to the horison. Thus, the heating of protrusions can be a
very significant part of the daily total surface heating (oven for a understably lay a)
when the new sur late (i.e., at higher insttudes), separally in winter). The interactions
with the armosphare (exchange of possible heat,
verporation/condensation processes) are generally with different for the protrusions and the
plant of the soil. The interaction is an especfacily different for the protrusions and the
plant of the soil, the interaction in a superface of the private of the daily total newface that the formal language of possible heat,
verporation/condensation processes) are generallay the different for the protrusions, in depensions (new lyself and the protrusions (as the
plant transfer to the admonstration are aspecface of th

3715 Chemical composition and chemical interactions
RADIATIVE - PROTOCHERICAL RESPONSE OF THE
MESOSPHERE TO DYNAMICAL FORCING
J. B. Frederick (Laboratory for Planetary Atmospheres, NASA/Goddard Space Plight Conter,
Greenbelt, MD 20771)
Combination of the Chemical

phares, NASA/Guddard Space Flight Conter, Greenbelt, MD 20771)
Combination of the chemical continuity equation for odd oxygen with the second law of thermodynamics yields snatytic solutions which describe the coupled behavior of temperature and cames perturbations in response to an externally specified forcing. The results uppear in a form which allows easy physical interpretation of the coupling between radiative and photochemical processes. When the forcing is chosen to misic a planetary scale wave, the theory shows that photochemical acceleration of radiative damping reduces the amplitude of the temperature perturbation by an amount which increases with the wave period. Although ozone fluctuations are anticorrelated with those in temperature, sinkme in ozone do not coincide exactly in longitude with temperatures saxias. The percentage variation in channel in temperature as a season of the contest of the c demonstrates that variations in oxone on constant pressure surfaces may sorve as a sensi-tive indicator of wave scrivity in the mescaphere. (Reduction substeparisty, carrel) J. Guophys. Res., Green, Paper 1C0145

1715 Chemical composition and chemical interactions
geasonat and LATITUDINAL VARIATION OF 1°CO AND THE TROPOSPHERIC CONCENTRATION OF OF RADICALS
A. Volz (Kernforschungsanlage Jülich, ICH 3, P.O. Box 1913, D-5170 Jülich, Germany) D.H. Shhalt and R.G. Derwent Ground-based measurements of the concentration of "CO are reported. The data exhibit a well-defined seasonal variation at midiatitudes with a maximum of 25:2 moleculo om during winter and a minimum of 11:1 molecule cm during summer. The measurements also indicate a strong latitudinal variation, with the lower concentrations occurring in the tropics. The data are interpreted using a 2-D time-dependent model. To balance the sources of both "CO and "CO, an average tropospheric OR concentration of (6.5::/) x 10° molecule cm ls required. In eddition, the "CO production rate from biological processos including the oxidation of nonmethane hydrocarbons is found to be 1250 x 101° g CO yr J.
J. Geophys. Res., Green. Paper 100061

3715 Chamical composition and chamical Inter-STRATOSPHERIC CHEMICAL AND THERMAL RESPONSE TO LONG-TERM VARIABLISTY IN SOLAR UP IRRADIANCE C. Brassur (lasticus d'Afronomia Spetiale de Belgique, 1180 Brussels - Belgium) P.C. Simon Beigique, 1180 Brussels - Beigium P.C. Simon A theoretical snelyels of the chemical response of the stratophere to possible lung-term variability of solar sitravioles irradiance has been performed, taking into account the thermal feedback effect on the reaction rates. Numerical values of sitraviolet and visible irradiation fluxes used in this work are given for seroment modeling purposes and a possible variability related to the livear solar cycle is suggested on the basis of recent and reliable observations of solar utradiants. This variability has been introduced in a stratosphoric two-disensional model which almulates the sensity everaged distriwhich almulates the monally everaged distri-bution of the chemical spacies related to the exygen, hydrogen, nitrogen and chirrine (a-milies. The results lead to a total exone variation of the order of) percent from the minimum to the maximum soler activity, with a maximum of about ten percent in the upper stratosphere. At these heights, the calcu-lated temperature frames is closed to 2-6 lated temperature change is close to 2-4 degrees. The H₂O concentration appears to be one of the most sensitive to long-term solar variability and a monitoring of this constituent would be useful to give information on the solar variability in the ultraviolet.

3715 Chemical composition and chemical interactions of the control of the control

(Solar variablility, trace species)
J. Geoghya, Bes., Green, Paper 100139

5720 Climatology
SOLAR VARIABILITY AND THE SECULAR VARIATION IN
THE TROPICAL TROPOPAUSE
K. S. Cage (Aeronomy Lab, National Oceanic and
Atmospheric Admin., 325 Broadway, Boulder, CO
80303) and G. C. Reid
The height of the tropopause at tropical Pacific
stations about a marked annual variation, together with a secular variation in the annual
average values. Prayious surhors have consented
on the positive correlation between the annual
average height and the sumspot number. The existence of this correlation to confirmed for the tence of this correlation is confirmed for the period 1932-72, and a mechanism to relate solar activity to tropical tropopausa height is proposed. The mechanism, which is a simple sitemism of one that will be discussed in detail elsewhers, explains the samual variation in tropopause height as a response to the samual variation in surface insolution and hence in the intensity of tropical cussilus convection and of the assauding branch of the Hadlay call. The correlation with the sumspot cycle can be as-plained if the solar "constant" undergoes a fractional increme of about 0.5% from solar minimum to solar maximum,

Grophys. Res. Lett., Paper 80L1782

1725 Convection, turbulence and diffusion
TURBULENCE AND SYMEMS DUE TO GRAVITY WAVE AND TIDAL SERANDOM

B. S. Lindsen (Center for Earth and Planetary
Physics, Marvard University, Cambridge, MA 07138)
It has been suggested (Lindsen, 1967, 1966s, b)
Lindsen and Blake, 1971; Hodges, 1969) that turbulence in the upper managhers arised from the
unstable breakdown of tides and gravity wayed.
Crudely speaking, it was symethed that sufficient
turbulence would be generated to prevent the
growth of wave soulitude with height (roughly as
thesis pressure)—1/2). This work has been extended to allow for the generation of turbulence by
mailer amplitude waves, the effects of sean winds
on the waves and the effects of the waves on the
many measure, budget. The effects of sean winds,
while of relatively small importance for tides,
are crudial for heternal gravity waves originating
in the trajectory. Minds in the trapoundary and
attributed and the proper seasophate.
In said that the generate burntlence, while the
stable of the partitude of critical levels in
the department of the property of the ability
of the first line partment of the
readgest of the first levels. The results of the
stable of the partment of the results of the
partment of the partment of the partment of the
partment of the partment o

low altitudes (50 km) and at higher altitudes in summer and during audden warmings (70-80 km), and decrease with height rather sharply above these levis. Bother observations are used to estimate momentum abposition by gravity waves. Accelerations of about 100 bys/dsy are suggested. Such close are entirely capable of producing accelerations are entirely capable of producing the warm winter and cold summer mesogauses. (Turbulence, wave stress, gravity waves, almosphoric tides). J. Geophys. Res., Green, Paper 100154

1735 Electrical phanomens
RTUMM STROKE VELOCITY MEASUREMENTS IN TWO TRIGGERD LIGHTHING FLASHEE
P.Hubert (CEA-Bacing, Service d'Electronique
PHysique, 8.P.H*2,91190 Gif-aur-Yvette.France)

Physique, 8.P.M°2.91190 dif-sur-Yvette.France)
G.Rouget
Triggred lightning experiments at St.Privat
Triggred lightning experiments at St.Privat
Triggred lightning experiments at St.Privat
Triggred firm and the electric curreturn stroke velocity V_{eg} and the electric curreturn stroke velocity V_{eg} and the electric curreturn stroke velocity V_{eg} and the electric curfor two switteroke triggred filadhem. For the
first strokes v_{eg} = 6.1 ½ 1.5 10 m/s with first = 6.2 ½ 2.5 km in reasonable agreement
with current theory. For nine subsequent strokes with rise time shorter than 1.5 µs, Imax
lies between 5.1 ½ 1 and 17.4 ½ 3 10 m/s. The
liktor values are 2 or 3 times higher than
predicted. J. Geophys. Res., Green, Paper 100230

1/45 Gravity waves, tides and compressions 1/15 Gravity waves, tides and compressional values
THE INSTABLITY OF ATMOSPHERIC GRAVITY MAVES
THEORY MAYE-HAVE INTERACTIONS.

7. C. Yeb (Department of Electrical Engineering, University of Illinois at Urbans-Champaign, Urbans II. 18101) C. S. Liu

We investigate the possibility of a propagating primary wave decaying into necondary waves through three-wave intoractions, Such a possibility exists in an inviscid isothermal strong-phere when the westload wavelength is small compared to the scale height. Initially, the amplitude of the accordary waves grows exponentially and this growth time decreases exponentially with height. This neems that as the primary wave propagation upward its sorray is centinuously trapsfered to the secondary waves. This transfer becomes increasingly rapid with increasing height. It is shown that this process can take place even when the local Richard-en number is unrare than 100, (indicating dynamic stability, igravity waves, usus-wave inter-action).

374) Gravity waves, tides, and compressional waves GRAVITY WAVE ACTIVITY IN VERTICAL WINDS OBSERVED BY THE PORCE PLAY MST RADAR I. L. E-blund (Asconomy Lab, Mational Oceanic and Amospharic Admin., Boulder, CO 80,003) K. S. Gage and A. C. Biddle

Owar 10 days of nearly continuous observations of the vertical wind up to 10 km obtained using part of the MST redar of Poker Play, Alessa, are presented in this report. These observations are typical of a longer 6-month set of observations and desonaterate assertal new features. The most

J. Geophys. Res., Green, Paper 1CO186

presented in this report. These appervations are typical of a longer 6-month set of observations and desconstrate seweral new features. The most obvious feature is the extent to which the magnitudes of the vartices wind fluctuations is controlled by propagating planetery scale waves, which modulate the large-scale wind field. Enhanced wind and wind shear in interms baroclinic stones greatly increase gravity wave settitives sem in the vertical winds. Although shorter period fluctuations in vertical valualty on occasion show very regular simusoidal cacillations with pariods from 5 to 30 minutes, typically the vartical valucity fluctuations are irregular with no well-defined oscillation period. Steady vertical winds of up to 1 m/s lesting for several hours are observed at certain law shall not see observed at certain law shall not are probably due to mountain las wave activity.

Coophys. Res. Lett., Paper 110135

3750 H.O in the atmosphere (humidity, clouds and 3750 %.0 in the atmosphere (humidity, clouds and Pracipitation)
(1000 MODIFICATION BY MAN-MADE POLLUTARTS: EFFECTS 07 A COAL-FIRED FONER PLANT ON CLOUD DROP SPECTRA 8. F. Pueschel (MOAA Air Rasources Laboratories. Boulder, CO). E. W. Barrett, D. L. Wellman and J. A. McQuire Pollutants from coal-fired power plants increase the drop model radii and broaden the drop spectra of stratocumlus clouds. Additional mater from the coal combustion leads to a measurable increase of the liquid water content of polluted clouds. Ipplied consequences are an increase of the co-alescence efficiency, an increase in acidity, and a change of the albedo of affected clouds. Coophya, Ree. Latt., Paper 110070

into Particles and Asymptosis
THE TRAISPORT OF HEAT, WATER VAPOR AND PARTICULATE
WITERIAL TO IME SOUTH POLAP PLATEAU
A. Regard(State University of New York at Albany,
1400 Washington Avenue, Albany, NY 1222)
S. Bernard, J. Samson and W. Winters
A systematic series of aerosal observations was
begue at South Pole in 1974. These observations was
tague at South Pole in 1974. These observations was
tone begue shortly after, and water vapor measuresents, using an slettrolytic cell were begun in
1975. Daring 1977 and 1978 atthorne aerosol and
seconological observations from an instrumented
10110g were used to construct varifical profiles
over the polar plateou, the Nose Sea and Boss Ice
thelf, and to make constant altitudo transacts from
the periphery to the interior of the continent.
Analysis of the althorne aerosol observations
shows that the most moist and merosol laden mir
ever the interior of the continent is found in, and
iven above the inversion, a few hundred meters
above the surface. Aerosol concentrations decrease
eacher the layer, to and through the tropopusse.
The marface merosol, water vapor and resperature
tector has been attraited by 20° machaned vind
direction occurring concurrent with the observation.
This englysis apports a simple meteorological model
of transport to the South Foler Plateau. When the
Polar high is centered over the center of the
Absertic ice mess, the moreal condition kelabatically reinforced week gradient wind occurs, and
south polar before a surface winds from the grid
cortheast. When this high is centered on the
December method week gradient wind occurs, and
sortheast. When this high is centered along the
datains, the air lase a long typicatory over ice
and arrives at falls along 930 deplated of heat,
vater vapor and serosol. Combining the surface and
althorad account of hoservations for analysis indicate that the preferred levels for transport of
troposphere.
J. Geophys, Res., Orsen, Feper 100147

Geophys. Reg., Green, Paper 100147

Mineralogy, Petrology, and Crystal Chemistry

440 Isotope mineralogy
Principle 702 COLD WATER CIRCULATION RT DEED SITE
195. ISOTOPES AND CREMETER OF ALTERNATION
LR. Lawrence (Leacht-Dobarty Deological Chemrustery, Falisades, N.Y., 10964) and J.I. Drawer
LBuntante of Geology, University of Mycalby,
Larenta, Wyoning 82070
Cypes isotope and chemical scalyses of seconcity alteration products at DEDP site 195 indicate sutents on products at DEDP site 195 indideep into besettic orbat possibly as repent as
Italiana.
Italiana.

I. Geophys. Res., Red, Paper 18D215

A260 Paragamesis, petrography, and patrogeomais. TUO-HICA GRAHITES OF MORTHEASTER MEVADA

D. E. Lae (U.S. Ceological Survey, Mail Stop 912, Faderal Center, Denvar, Colorado, 80225)

R. D. Kietler, I. Friedan, and R. E. Van Lossen. The field settings are described and analytical data are presented for six two-pics granites from mortheastern Baveds. High 450 and 5757557 values indicate that all are 5-type granites, derived from continental creat. The major element chemistry and accessory sineral contents of these rocks also are chatacteristic of 5-type granites.

Chamical, X-ray and other data are presented for the micas recovered from these granites. The muscovites are notably high in Feydy, FeO, and MgO. Except for one hydrobicita, each of the biotice has an HgD content near 6.0 weight parcent.

To different trans of the parameter of the parcent.

blotites has an NgO content near 5.0 weight percent.

Two different types of two-mice granices are recognized in the area of this stody. One type is different types by the presents of many biotite subsdra within susceptite phenocrysts and by as unusual soits of accessory minerals completely david of opeque saides. This type probably resulted from anguais of late Procesbrian argilites under conditions of relatively low oxygen fugacity, along a line that roughly coincides with the westward disapparance of continental basesels.

In the other tentural type of two-mice granite the mices are equipresular and there is a greater variety of accessory minerals. The magnetic evolution of this type also appears to reflect the influence of late Precembigs argillites; there may be age differences between the two types of two-mice granites. (Granite, mices, anatexis, isotopes).

anatewis, isotopas). J. Geophys. Res., Rei, Papar 18016]

dead Paragenesis, patrography and patrogenesis could admit the further patrol of the p The like complet is sumilar in range respects the like complet is sumilar in range respects that the complet is sumilar in range respects that of sid-ocean ringe begant (2003) and yield likely effect ratios that ever lap with ratios predicted for perent liquids of the eventual success. Including the liquids of the eventual success in relative that the lapse of the eventual success. Including the lapse of the eventual success and the eventual

4260 Paragenesis, petrography, and petrogenesis LATE CENIZUIC VOLCAMISH AF THIN PEAKS, UIAH PART II GEOLOGY AND PETROLOGY H. H. Lrecraft, M. P. Hash, and S. H. Evans, Jr., (Department of Geology and Chophysics, University of Utah, Salt Lake City, Utah Bell2) Gaology and compensions, can be also considered in the Twin Peaks wilcanic complex, west-central Utah, spanned a period from 2.7 to 51 m.y., and produced approximately 12 km of erupted material. Two sequences of differentiation can be discerned in the silicic lawas; both are cheracterized by increases in S102 from 715 to 785 and decreases in temperature from 875°C to 775°C. The first sequence srupted from 2.7 to 2.5 m.y., produced 2.00 km² of aphyric lawas and pyreclastic deposits and resulted in a local submidence of approximately 100 meters. Tuffaceous lake deposits followed by volunthous cliviae tholelitus subsequently filled the depression. Fruption of the second sequence of silicic rocks, spanned a short time at 2.4 m.y. and produced a tatal volume of 7 km² of strongly porphyritic feisites. At least two subsequent estables of basalitic volcanism followed. Chemical variations displayed by the darly differentiation sequence of silicic rocks are characterized by increases in volatiles, Si02; characterized by increases in all other major components, light rare earths, Sr, and Ba. Inose variations in compositionally, some ash from variations in compositionally same ash from variations in compositionally straigles and the sequence resulted in the development of a highly evolved compositionally straigles displayed by explaced requires thermal input into the system, pr Bimodal volcanism that formed in the Twin Peaks

J. Geophys. Ros., Red, Paper 130212

Oceanography

4740 Marine geological procuses
MANTENANCE OF THE SHOREFACE BY WAVE
ORBITAL CURRENTS AND MEAN FLOW;
OBSERVATIONS FROM THE LONG ISLAND COAST
A. W. Medoreds (Woodward Clyde Committants, 7330)
Westelves Drive, Housion, Texas 770551 and D. J. P.
Seift
Waves and currents were observed on the Long Island
coast for a total of 36 days in August 1976 and 1977,
and estimates of sediment transport have been
calculated. Calculations of wave transport of sediment,
using a Bagnold equation for transport and second order
stokes theory, show that wave orbital current
sayametry results in landward sediment transport. In 10
m or lam water dopth, but does not significantly effect
transport using the Madeon-Chant formulation show that
during the observation period sediment in less than 10 m
of water generally moved landward into the breaker and
then siong coast with the wave-driven littoral flow.
Calculations show that below 10 m the generally
upwelling coast-parallel mean flow did not move
sediment. However, during two days of a mild summer
"not beastor" storm, a downwelling coastel jet
developed, with 50 cm sec' maximum currents. The
calculations show that if this flow had been combined
with the intense wave regime of the succending awersal
days, sodiment would have been estrained across the
lower as well as the upper shore face. Movement would
have been oftshore and sloogshore. Such storm
transport is believed to be typical of the more intense
winter atorms, and responsible for the economial
aboraface retreat that has caused up to a kilometer of
shoreline retreat on the Long Island coast in the last
cantury. (Shorelace, wave-orbital currents, whid-driven
currents, send transport).
Geophys, Res. Latt., Paper 11,0177 currents, sand Manaport). Geophys. Res. Lett., Paper 110177

4750 Physical properties of seawater TWE INFLUENCE OF OPTICAL WATER 17PE ON TWE HEATING RATE OF A COMSTANT DEPTH MISED LAFER J. Romald V. Zeneveld (School of Oceano graphy, Oregon State University, Corvallis, OR 4731) James C. Kitchen and Hasong Patha a simple heat budget model for a radiation-dominated mixed layer of constant dapth is presented. In this model the influence of the vertical irradiance (heat flue) profile is easiened by means of Jertov's (1976) optical water type classification. It is shown that the vertical irradiance profile is taportant in determining the mixed layer heating rate. The heating rate waries greatly as a function of water type, mixed layer depth, and diffusivity baneath the mixed layer, ranging from 0.098*C/day for occanic water type I with a mixed layer depth of 70 m and diffusivity beneath the mixed layer of 1.0 cm² sec*l to 0.316*C/day for occastal type

9 with a mixed layer depth of 10 m and sero dis-fusivity beneath the mixed layer, a variation of more than a factor of 3. Heat flux, irradiance. J. Geophyn. Res., Green, Paper 100121

4765 Euriace waves, tides, and see level
a COSMADISCH OF ERRANT'S AUTHOLIEF MEASURHMENTS
OF MAUX SECURT WITH HYPSURIMENTS HAVE BY A
PITCH-POLL BUY
B.J. Wich (Institute of Occarographic Sciences,
Mornloy, Occarographic Sciences,
Mornloy, Occarographic Sciences,
Mornloy occarographic Sciences
As a patch-roll busy during the JASIN experience
are congressed with measurements as the secothrough the Separation and attemption of the second occarions during which the significant wave.
Moting the best of the second occarographic sciences of the second occarographic sciences of the second occarographic such the pitch-roll busy. The coar satio of the beautropoint as
0.962 O.Os, and the standard devilition of individual acceptations about this measures.

4340 Instruments and techniques bettering the Movement of McEaste PROTES Situa REGISTERED TIPUS-H INDIERY J. R. Clark (Newel Ocean Rosearch and Development Activity, ASIL Station, MS 19529) and P. E.

- 11 i

. .

Activity, Noti Station, MS 195291 and P. E.
Lavioletie
An expaloution of TIROS-9 AVERR data distributed by BOAA Environmental Data Information
Service (EDIS) shows that with these dara one
has greatly inproved positioning capability in
comparison with data gathered by wartler NOAA
actelities. In four of five distinct TIPOS-9 data
sets, incolving curth scenes approximately 100 km
square, we obtained a mean positioning after of
1.7 km with a standard deviation of 1.7 km based
on 12 landark points. The fifth data set above
distributed apparently resulting from erronous
FBIS data conditables, and accurate positioning
of this apocific as one could not be made. In genoral, Tibro-8 data can be reliably registered into
geographic grids of various may projections by
uning two-diseasional, third-unier polymodials.
The resulting image projections can be used to
mention all to Economy the measurems of meanifronts accurately. Econples of much capacitaries
are presented using data from the Nav 1979 phase
of the stand Banks Kajarlients. Those escapics
include four convenitive data of registered of the stand Banka Kaperizenta. These essaples include four consecutive data of registered Times-B imagery that show detailed southwasterly movement of horizontal frontal waves traveling at an average appeal of To induce. The accurate registeration also utilize precise compositing of everal days' imagery. A four-day emposite passed on the highest daily imperature per pixel position, about that an occasic front can often by monitored despite cloud conditions. (Title-S.

Oceanology Volume 19 Number 4, 1979

CONTENTS

Physics of the sea Behave V(S). Nordrin Yu(V) On the vertical spectra of fine structure of the tentperature field in the frontal zone

Zhikharev G. M., Scidov D. G. Numerical studies of the evolution of synoptic scale currents in a barotropic model of the open occur.

Makarevich V. A. On the methods for a diagnostic calculation of currents.

Burkov V. A., Kuksa V. I., Dyadyanov V. N. The influence of intermediate waters. on the World Ocean circulation

Burkov V. A. Pavlova Yu. V. The synoptic eddy field in the Kuroshio

Bryantsee V. A., Pavlokhia S. V., Pelevia A. S. Peculiarities of the geostrophic currents and the subtropical convergence zone in the south-western part of the Indian Ocean

Neuymin G. G., Sorokha N. A., Tinchenko I. E. The construction of the light attenuation coefficient field in the Tropical Atlantic by the objective analysis method Kistov A. V. Atmospheric circulation and the transparency field formation above the GARP Atlantic Tropical Experiment region

593

608

Marine chemistry

Lukushev Yu. F., Chernyakova A. M. Variability of nitrate fields due to the passing of eddy formations
Mirking S. D. Enzymatic activity and ATP in the waters of the north-western Indian Ocean

Rusanov V. P., Shpaither A. O. Advection of dissolved silicic acid in the Chuckchee

Sea

Tikhomirov V. N., Gromov V. V., Konnov V. A. Sorption of ahiogenic and biogenic forms of manganese and nickel by carbonate sediments of the Indian Ocean Geodekyan A. A., Trotsyak V. Ya., Avillov V. I., Berlin Yu. M., Bolshakov A. M., Zhittnets R. P. Hydrocarbonic gases in the Baltic Sea waters

626

627

628

628

628

628

Marine geology Neprochnov Yu. P., Merklin L. R., Shreider A. A., Sedov V. V., Eluikov I. N. Structure of the East Indian Ridge based on the Integrated geophysical studies Gorbunova Z. N. Clay minerals of the north-western Pacific (materials of Leg 6 Gorbunovo Z. N. Clay minerals of the north-western Pacific (materials of Leg 6 of the «Glomar Challenger»)

Seonst yanova E. S., Golovina M. S., Pilipchuk M. F. Phosphorus redistribution in Upper Quaternary sediments of the Ionian Sea

Badyukov D. D., Kaplin P. A. Sea-level changes on the Far-Eastern and the Arctic coasts of the USSR for the recent 15 000 years

Davdariant A. S., Speransky N. S. The role of mechanical differentiation in the formation of shelves with relict sediments.

Leon'av I. O., Speransky N. S. Sindles of water transport by waves in the near-speca and of the sea. ore zone of the sea

Marine biology

Kabanova Yu. G., Domanov M. M. Influence of nutrients on the growth and functioning of plankton in the Cuban waters.

Kondrat eva T. M., Burlakova Z. P. Accumulation of dissolved organic matter and the role of organotrophy in the total production of microorganisms of the Black See and the Atlantic Ocean

Kozun Yu. V., Nesis K. N., Nigmatullin Ch. M., Ostapenko A. A., Pinchukov M. A.

New data on the distribution of squids, family Ommastrephidae, in the World

Observational methods and instruments Ocodekyan A. A., Neprochnov Yu. P., El'nikov I. N., Dubovskoy J. T., Pohryshkin A. A., Eusyakov Yu. D., Sviridov N. I. Experience of seismic refraction profiling in the Baltic Sea Neprochnov Yu. P., Mcrkiin L. R., El'nikov I. N. Continuous seismic profiling in the ocean at a ship's speed of about 15 knots.

Vasiliev V. P., Kostogiodov V. V. Data processing of a continuous underwater gamma-survey and determination of the concentration of interal components in marine bottom sediments (based on the results of the 1975 Soviel-Polish Expedition) Expedition)
Shreider A. A., Valyashko G. M., Peranov B. S., Prokhorenko E. A. Experience of the use of the KM-3 towed component magnetometer for the magnetic field studies in the ocean Gurevich I. Ya., Kokorin A. M., Shifrin K. S. Radiometric and visual contrasts of oil illms in the ses Vedernikov V. I., Sukhanova I. N. On the melliods for determining phytoplankton numbers with the use of the nuclear filters Information

Udinises G. B. Paulenkoon N. I. The 1st cruise of the «Georgiy Maksimov» under the programme of the O. Yu. Shmidi Institute of the Earth's Physics, the USSR Academy of Sciences

1990 Tides
The tops (choosed byth stores foreign at a few tops (choosed byth stores foreign and a few tops (choosed byth stores foreign) and provide a few tops (choosed byth stores foreign). The crops taked by using the contested byth stores foreign and stores foreign by the contested byth stores foreign by the contested by the formie.

1 1

5 (B. G.)

Particles and Fields-Interplanetary Space

Child transfer as a law father Proving Distri-Bution. At Properties. Phiripal Austran; condi-tived: A Chapter applied Plante I to practice. The John Bighton Pulversity, Laurel, 24., 202(6). A constrict simulation but from developed to study the insertion in the Intendiction of the transfer with the passage of Flare-produced fasteries with the fire fasteries and the passage which the distriction of the fasteries of the passage and the fasteries of the passage of the passage of the standard electric field each ties it crosses the abook. The time-respect religiation reveals with of the charter proton interacted with the 41 ks, where the interaction protons bi-metic process was increased a tree shows. with of the chervel protons interacted with the at the whose stocked by the attention occurred, and it he has not been accounted to the shock. The protons are shock in the stocked protons are shock in the stocked protons are shocked protons and protons and shocked protons are shocked protons are shown to an exceptional proton indistrictions of the special aspects of the shocked proton and districtions of the special aspects of the shocked proton are plann for silfferent charges proton are plann for silfferent charges proton are plann for silfferent charges proton are plan and stength, the shope of the artists proton energy specture, the satisfaction of the angle 6, between the shown are shown as the satisfaction of the shocked for extra the satisfaction of the shocked for extra the satisfaction of the shocked for extra the satisfaction of the shocked for stocked for stocked the stocked contact the samilation shock correctly recovered to stocked the stocked correctly recovered and stocked correctly recovered and stocked correctly recovered and stocked correctly recovered and stocked correctly as shown and satisfaction and so the stocked stocked the stocked the stocked and stocked stocked the stocked

The related attraction of the tented of the tented of the related properties. The related properties of the related proper

@

4

Ç

2

to the chief Branch Blass topics (1000)

Anton the grow and the service of th

The San into Jet Epper south interpretable of crimaces (Ceparamet of Physics, Indecrine of Signers, Ceparamet of Physics, Indecrine of Signers, Ceparamet of Physics, Indecrine of Signers, Ceparametric Services and Services of the control of the c en: banism is teadily ment, to be and for them Garphyo. Acr., Mice, Paper Singles

I WI Shell bares

Contained Southers for the present thankyfive Art the break-off distrible of the bolan wind
five Art the break-off distrible of the bolan wind
finemential serve

F. Preside Contain System Cable, ver,
C-last Friedrichebers i, best Cormany
it is commonly belowed that the supersonic souler was feel by present in a strong shark at position where its present is balanced by the grascase of the interestation endian. Presented
from the bolan wind in a fluid dynamic phenomercase of the interestation endian. Transpersing
from the bolan wind in a fluid dynamic phenomercase of the interestation expectation for the
prand-off distance as well at for the presentfices were derived from the simplified landingfices and from the derived the distant veloc wind
is more libely to have mail back embeds (fc.)
because it is bested and decalarated by may found
continuously crasted from interestable measure
gas. Fureface, Jaring's equations are estended
do accommonte existivary Hard members wing the
urability equation-supposet relations, plus the
firm, and charge exchange reactions. The
second of a wind found to the polygraphs post-shack
firm and charge exchange reactions. The
expective of whether er not these violes are inexpective of whether er not these violes are in-

5340 Shock waves

5340 Shock waves

536 SI-DIRECTIONAL STREAMING OF SOLAR WIND ELECTRONS

530 SYP JOZE EVIDENCE FOR A CLOSED-FIELD STRUCTURE
MITHIN THE PRIVER GAS OF AN INTERPLANTIATS SHOCK

5. J. Barry, (P.-A., MS 436. Los Almos Metional
Laboratory, Los Almos, FN 87545) J. R. Asbridge,
W. C. Felombar & T. Gosting, and R. D. Zwinki
In near time coincidence with the strivel of
hellum estiphed plenth driving the shock wave
disturbanch; 45 Movember 12-13, 1978, strong bidirectional streaming of balar wind electrons >-60

of Mans observed with Los Almost instrumentation on
1922 3. The syright los Almost instrumentation on
1922 3. The syright los Almost instrumentation on
1922 3. The syright los Almost instrumentation on
1924 3. The syright los Almost instrumentation on
1924 3. The syright los Almost instrumentation on
1924 3. The syright los Almost instrumentation
1925 3. The syright los Almost instrumentation
1926 3. The syright los Almost instrumentation
1926 3. The syright los Almost instrumentation
1926 3. The syright los Almost instrumentation
1927 3. The syright los Almost instrumentation
1926 3. The syright los Almost instrumentation
1926 3. The syright los Almost instrumentation
1927 3. The syright los Almost instrumentation
1927 3. The syright los Almost instrumentation
1927 3. The syright los Almost instrumentation
1928 3. The syright los Almost instrumentation
1927 3. The syright los Almost instrumentation
1927 3. The syright los Almost instrumentation
1928 3. The shock wave in the syright los Almost instrumentation
1928 3. The syright los Almost instrumentation
1928 3. The shock wave in the syright los Almost instrumentation
1927 3. The syright los Almost instrumentation
1927 3. The syright los Almost instrumentation
1928 3. The shock wave in the syright los Almost instrumentation
1928 3. The shock wave in the syright los Almost instrumentation
1928 3. The shock wave in the syright los Almost instrumentation
1928 3. The shock wave in the syright los Almost instrumentation
1928 3. The shock wave in the

5350 Solar wind Interactions with nonn and planeta
UNSTREAM PARTICLES OBSERVED IN THE SANTR'S
PORPSHIPE, REFINA
T. K. FASTMAN, R. H. Anderson, L. A. Frank
Repartment of Physics and Astronous; (University
of Lowa, Iows City, Iowa 52242) and O. K. Parks

Begardmant of Physics and Astronous, (University of Iowa, lows City, Iowa 5224) and n. R. Parks

Beand primarily on an extensive atmly of fully three-dimensional places data, we describe the interrelationships of the upstrone particles and plassa aways observed in the carth's foreshock region. The University of Iowa LREGORA detections and electrons from 1 av to 45 keV over all except ~ 28 of the unit sphers. Tomparisons are made with high time remaintion particle data obtained by the University of California (Serkeley) instruments and plasma wave data collected by the University of Iowa plasma wave instruments on the two 1922 apacacraft. The pressure of ion bears of Jettonous It was a formation of the pressure of electronistic and electronistic wave antesions. Described an electronistic wave antesions. Described in the correlations of Ions with plasma wave data a teach of an Ion sutpoperind indicate that ion-accust to enhanted when increased anisatropies and gyrophase organization are observed. Tion alianing affects limit the interpretation of volucity distributions taken within the foreshock region. High time resolution ("repolations between the different instruments, heaven; deconstrate that the waristions of a stable isotropic or anisotropic distribution cannot produce the dispersed for distribution data reveals that the upstroon particles undersys significant apatisl and temporal warisations incleding gyraphase granus of ions are followed in a stable isotropic or anisotropic organisation comprises groups of ions or institution data reveals that the upstroon particles and particles undersys significant apatisl and temporal warisations for leaster section and with inspect tield and plasma wave data, as find that (1) ions observed in the forestick region display gyrophase organization produced by the clustery with a spatial scale (1) for electronism and produced by the clustery with a spatial scale (1) for electronism and produced by the clustery with a spatial scale (1) for electronism and produced by the clu

5370 Solar wind magnetic fields IMP Enhancements Associated with Streams: An Analysis of the Magnetic Field Behaviour. U.Villante (Istituto Pisico, Università,

L'Aquila).
We examined the interplanetary magnetic field behaviour in the field enhancement regions associated with the high velocity stream Fronts observed during the primary mission of Kelios 2 (January through April, 1976). The principal con-clusions of our investigation are the Classions or our investigation are the following: a) the relative variation of the field magnitude ranges between 1,3 and 1,8 and is independent of belicenand 1.8 and is independent of heliocen-tric distance at least between 0.3 and 1 AV; b) Close to the sector boundaries the field enhancements are consistent with a field perturbation occurring in a plane perpendicular to both the solar equator and the radial direction; c) The field line has occasionally the form of a cylindrical helix rather than a simple planer geometry; d) There is no compel-ling evidence to relate, in the inner solar system and in the period of inte-rest, the field enhancements with the Shape and location of the sector shape and location of the sector boundary surface. J. Sechja. Hes., 32us, Paper 140106

5189 Solar Wind Plasma

LIPSTREAM PARTICLE SPATIAL GRADIENTS AND PLASMA USSIFIEM PARTICLE SPATIAL GRADIENTS AND PLASMA MAYES
G. K. Parks (University of Mashington, Seattle, Mashington), E. Greenstedt, C.S. No. C.S. Lin, Mashington), E. Greenstedt, C.S. No. C.S. Lin, M. Ashington), E. Gurgiolo, B. Much, M. Pere, R. Anderson and T. Estman The Lysterau electron and ion fluxes detected by Our experiment on ISEE 1/2 spacecraft undergo frequent time variations, From a few seconds to minutes. Many flux variations correlate with directional changes of the interplanetary magnetic field (1MF). Particles propagating in the upstream region acted on by the solar wind electric field creates a quasi-stationary particle pattern in space. Evidently, the spacecraft frequently crosses, the boundaries of these particle patterns, they enables are usually spatial variations that have been composited into our data. Estitime variations are usually spatial variations that have been consolited into our data. Estimates of the thickness of the particle boundaries chused is C i Larmyr radius (for both the upstream electron and ion events). Plasma waves are observed in association with the upstream particle flures and a correlation between the amplitudes and the particle boundaries is suggested. We will theoretically show that the ion and electron density gradiesis across the toundary play an isportant role in exciting the ion acceptable. He and plasma waves.

J. Desphys. New., Blue, Paper LAGIO?

\$150 Solar Vind Plasma ALCAR CHORD SPEED STREAM.
ALCAR CHORDOPMANIC INTERACTION OF MICH SPEED STREAM.

7.6 Whang (Cathol's University of America, Wathington, O.C. 2006.) and T.M. Chief Boweries solutions of superalopyrodynamic squations are carried out to describe the confiscer interaction of corotating high-speed streams marrial season of the second of the second stream from the solar acquiterial plane. The problems are such that solar acquiterial plane is to simulate the evolution of an idealized high-speed stream. Reserved salutions are obtained to represent the variations are flow wincity, supported field, plasma shoulder, temperature and conduction heat flux in the interaction region. They deconstrate that Da thermal structure of a high-speed stream traction between the structure of a high-speed stream conduction process. The second problem deaths with the formation of corotating shock sever leasting from the enging of characteristic curves, formation and second stream resulting from the enging of characteristic curves, formatics a reverse shock so not necessarily occur in factors at the characteristic curves.

Corotating Shocks, searby. (Carotasing Surames)

NAI-EMB CRIERED TON BEAUS UPCTREAM OF THE EARTH'S NAI-EMB CRIERED TON BEAUS UPCTREAM OF THE EARTH'S NAI-EMB CRIERED TON BEAUS UPCTREAM OF THE EARTH'S NAI-EMB CRITICAL AND ADDRESS ENVISION, decraveles Program, Seattle, UM 931951 O. A. Parks, B. H. Kank, C. S. Lin, K. A. Anderson, R. P. Lin, and H. Reme

The unexpected appearance of spin modulations in our fixed voltage electrostable analyser detectors on LEE 1/2 has given us the opportunity to investigate the plasma properties of the upotross form in high time resolution. The detectors are narrouly collinated and point southward, antiparallel to the satellite spin axis covering a region in plase space not viewed by the other plasma experiments on the satellites. The count rate modulations (up to three orders of magnitude) are due to the convolution of the animotropic detector response function, and reflect the existence of strong velocity gendlents in the local interduction function. By assuming a form for this distribution function, we can simulate the output of any of our detectors. Comparing the simulated and observed count rates, we can then estimate sourced of the local plasma parameters. This, of course, is dependent upon the distribution function cases. Using an isotropic "flowing" Machellian distribution (which should be thought of as a "local" approximation to the actual distribution near the region in plase apace occupied by our detector response function), we have obtained estimates of the local plasma temporature and three-dimensional flow velocity of the upstream particles, there exists beachills ons with the previously dynamic in velocity with changes of 200 to 300 kn/sec courring in 3 to 6 econds being corner. Most significantly, thair "flow" welcoides cannot be ordered by EbB. This last point separates these deservations of upstream particles, there exists beachille topa with the previously reported reflected and diffuse populations of upstream irons. Rechamisms that can gyrophase bunch the lors reflected and the bow shock are discussed as a meth 5360 Colon wind **plasma** NON-ENB ORIENED TOXI BEAUS UPSTREAM OF THE EARTH'S

5380 Solar wied plasma VAVE-ELECTRON INTERACTIONS IN THE HIGH SPEED SOLAR WIND

SOLAR WIND

S.J. Schwartz (Queen Mary College, Mile End Road, London El 483, Great Britein), V. C. Feldman and S. P. Gary

We investigate the role of pleasant wave-particle interactions for modifying the electron velocity distributions of the high speed solar wind. Both electrostatic and electromagnatic fluctuations are considered. We find that interactions between themsel electrone and a small fraction of the observed wave spectrum provide a townentum exchange rate strong amough to compete with Coulomb collisions. (Interaccions, solar wind).

J. Geophys. Res., Blue, Paper 140135

Particles and Fields lonosphere

5505 Airglow
SIMULTANFOUS OBSERVATIONS OF 01 7774 % AND [01]
6000 Å EMISSIONS AND CORRELATIVE GRUDY WITH
10-OSPHARIC PARKETERS
1. Sahai, J.A. Bittencourt, M.R. Teixeira and
M. Takahashi (Institute de Peaquisas Espaciale,
Conselho Nacional do Deservolvimento Cientifico
Flornológio, 12200 São José des Campos, S.P.,
878811)

Frasilian (17:00 Sao Jose des Campos, S.P., Brasilian Regular masaerements of the 01 7774 Å and [01] 6100 Å nightglow emissions were garried out at Cachoeira Paulista (22.7%, 45.04%, Barzil, during the period of April 1918 to March 1979. An ionosonde is sino operated at Cachoeira Paulista. A corrolative atudy of the 01 7774 Å and [01] 6190 Å emission observations, with simulataneous ionosonde measurements, shows good correlations between (17.7%) 1/4 and F-layer peak cleatron doneity in (e)), and between the ratio (17.7%, 1/4) (14.900) and the height of the F-layer (L. F2), where 17.7% and Jagon are the column emissions state for the 01 7774 Å and [01] 6100 Å emissions, respectively. Significance we weaksurements of these two emissions would be a very useful rechnique for remote seconing of the lonospheric F-layer dynamics. (01 7774 Å, (01) 6300 Å, ionospheric permeters). Geophys. Res., Blus, Paper 80A1797

5505 ALERION S MISSION IN THE TERRESTRIAL NUMBERS OF STREET

T. G. Sianger and D. L. Musetia (Mulacular Physics Laboratory, SSI International, Manio Perk, CA 94023)

Synthetic spectra have been calculated (neor-posting three 0.2 entealon, systema, Alu-+ X.T. Alu-+ Alu- and ct. - X.T. and although the synthesis macquisited the inclusion of the C. - X.T. ayarum, which has sever been previously identified in the air-slow, although it is a dominant system in the Yanosian nightglow. The passassons from the astronety matsatole. Alu-hand c. attaca account for half the radiation in the Monosian nightglow. The passassons from the astronety matsatole of the Monosian of the Monosian nightglow. The passassons from the 3400 A region, from which it my be deduced that the emospheric concentrations of 0.410. A radiation of 0.410. A radiation of 0.410. The vibrational discributions are dustaunteleved for all three states, . Coophys. Res., Blue, Paper 140076

5505 Airglov MATIONS OF MEUTRAL LROW EN1951ON IN TVI-OBSERVATIONS OF SENTRAL IRON EMISSION IN TYI-LICRI SPECTRA C. A. Tapley (Space Physics Research Laboratory, Dept. of Atmospheric and Oceanic Science, The University of Michigan, Ann Arbor, MI 48103) J. W. Meriwather, Jr., J. C. O. Walker and J. D. Mathaus

Mathews
We present a method for the analysis of twilight singles spectra that may be contaminated
by atmospheric continues emission of unknown
brightness. The necessity of correcting for
this continues makes on when measuring weak mirglow features in twilight is illustrated by
spricetion of the mathod to the neutral iron
line at 1860A.
J. Geophys. Hes., Plue, Paper 140132

Sili Autoras
PORAR CAP ARCS AND THE FLARMA SHEET
Ching-1. Heng (Applied Physica Laboratory, The
Johns Nopkins University, Larie, Md., 20810)
This letter seggests that now of the soceiled 'polar cap ares' with the sum-sligned
region occurring during the quiescent magnatise hardward owel as Capaquence of the polateephers are actually a part of discrats area in
the autoral owel as Capaquence of the polarsurfection is beend on (1) a distalled examination of two boaths of DREF electron practiculation data and simultaneous surcoral observation, (2) the observed widening in the
tration to the vary high geomegantic latitude
istinucianal extent by the avairant own precipciation data and simultaneous surcoral open preciptions, (2) the observed widening in the
tration to the vary high geomegantic latitude
sus-aligned area, see (3) the doningnate widening
of the quiet carveral own over both the morthern
testing of the propent under specific it disquared in
the company of the propent under specific the solar
testing the solar testing the solar testing the solar testing the solar testing the solar testing the solar testing the solar testing the solar testing the solar testing the solar testing the solar testing the solar testing the solar testing the solar testing the solar testing the solar testing the solar testing testing the solar testing the sol

5515 Auroras Spatial Aspects of Electron Energy Degradation SPATIAL ASPECTS OF ELECTRON EMERGY DEGRADATION IN ATOMIC OXYREN
R. P. Singhal and A. E. S. Green (University of Florida, Gainesville, Florida 22611 Spatial (radial and longitudinal) yield apectra for electron emergy degradation in atomic oxygen have been obtained using a Monte Carlo method for 25 eV to 10 XeV incident electrons. Four dimensional yield spectra have been analytically represented in tarms of a modal containing three simple microplumes. We find that the scaled spatial yield spectra for 0 is approximately the same as for Ng. This feature provides a basis for inferring yield spectra for any atmosphere gas or mixture of gases. [Electron energy degredation].
J. Geophys. Rau., Blus, Paper LADIZS

5515 AUTOFES UPPER LIMITS FOR X-RAY AND EMERGETIC SEUTRAL PARTICLE EMISSION FROM JUPITERI VOYAGER-I UPPER LIMITS FOR X-RAY AND EMERGETIC SEUTRAL PARTICLE EMISSION FROM JUPITER: VOYAGER-I RESULTS

E. Kirsch (Max-Planck Institute for Asronosy, D-341 Kattenburg-Lindau 1, West Germany

S. M. Krimigis (Applied Physics Laboratory/The Johns Hopkins University, Laurel, Haryland 20810) J. M. Kohi sad E. P. Keath

The x-ray sensitivity of the low energy proton channels in the low Energy Charges Particle (LECP) experiment and its directional measurements are used to determine whether x-rays from Jupiter can be recognised as additional flux above background as Voyager 1 approached the pleast. Between - 230 and ~ 100 R₁ a statistically significant count rate was detected which we interpret as x-rays and/or neutral particles. The upper limit for x-rays, related to earth-bysed measurements is
 1.3 x 10^4 photons/comeck eV in the energy range it to 31 keV. Such an x-ray flux leads to estimates of precipitating electron intensities over the Jovian polar caps which are ~ 200 times larger than observed electron fluxes in the lo plessa torus. The same upper limit, corresponds to < 4 x 10^5 neutral particles/cu²sec keV at 100 R, distance from Jupiter. We favor the neutral hypothesis, and estimate that is represente a loss of
 10^2 atoms/sec, i.e., 0.03% of the atoms generated by Is's volcanose.

 Capphys. Res. Lett., Paper 801.1781

5515 AUTOTAS
AUTOTAS
AUTOTAS
AUTOTAS
AR-C AND THE CHATAFILA RADAR
C. de la Basujardière (SRI International,
333 Ravanswoud Avanua, Henlo Park, California
94025) R. Vondrak, R. Healis, W. Eansou, R.
Hoffman

South A. Vondrak, R. Healis, W. Hanson, R. Hoffman Autoral are electrodynamic parabeters are studied using coordinated measurements between the AE-C satellite and the Charante rader. On January 4, 1978 the spaceraft twice crossed an east-west-aligned autoral are at widely spaced longitudes, spanning more than three bours in local time. The Chetanite rader was scanning in elevation at a magnetic longitude equidistent from the two AE-C crossings. The slectric field pattern around this are was remarkably similar at the three longitudes. Equatorward of the arc, the morth-south field was very intense (4 50 mV/m), whereas, poleward of the arc, it was small in 10 mV/m). The ener-west field was usuall and almost constant across the arc. The same are was observed by the rader during about one bour, and this electric field pattern did not change, awon though the arc location, intensity and width changed substantially. The ion and electron temperature variations around this arc were also satudied. For a given electric field the AE-C measured ion temperature was substantially different during about for bour field the AE-C measured ion temperature was substantially different during about for bour feel and field and field and field around the arc location intensity and field when the arc field the AE-C measured ion temperature was substantially different during about or bour. measured ion temperature was substantially dif-ferent during each of the arc crossings. This dissimilarity is attributed to differences in the F-region neutral wind at the two longitudes. We show that the electric field variations are con-Alexant with the extreme of polarization charges within the arc. even though the electric field remained easil poleward of the arc. (surran) arc. electric field. conductivities, currants).
J. Geophys. Res., Slue, Paper 140216

S520 Electric fields
MEASUREMENTS OF IOMOSPHERIC ELECTRIC FIELD CONVECTION BY THE LONG-LINE IECHNIQUE
J.W. MacDougall (Centre for Radio Science and
faculty of Engineering Science. University of
Mestern Ontario, London, (anada #64 Nr)
Lonospheric E x B convections are measured by
a new technique which uses satellite scintillations. The measurements are for an ionospheric
region centrad on 19°M, 82°M geographic or 53°
invariant latitudo. Results are presented for
spring aquinox 1980. Quiet condition estward
convection drift is approximately Y₁ = -12 * 43
2** cns $\frac{2\pi}{2A}$ (t - 13.4). During disturbed conditions at nighttime the westward convection becomes large and highly variable. The northward perpendicular E x B convection is approximately V_{in} =

-5 + 13 con 2n (t - 10.5) + 6 cos 27 (t - 11.6) m/s during quiet conditions. During disturbed conditions the semidiurnal component of the northward convection facreases by about a factor of 3 and becomes larger than the diurnal. (Electric fields, convection, trough, disturbaces). J. Geophys. Rom., Blue, Paper IA0185

5530 High-latitude ionospheric currents OBSERVATIONAL EVIDENCE FOR A SOURCART LAYER SOURCE OF DAYSTBE REGION I FIELD-ALIGNED

SOURCE OF DAYSTDE REGION I FIELD-ALLORED
CURRANTS
P. F. Bythrow (Canter for Space Sciences, Physics
Program, Univ. of Taxas at Dallas, Richardson, TX
73080) R. A. Healis, N. B. Rangon, R. A. Power
and R. A. Boffman
The addition of megnetic field seasurecepts to
the Atmosphere Explorer-C date base has enabled
us to examine the relations between field-aligned
currents (TAC), energetic particles and plasma
convection in the high latitude lonesphere. We
observe that in general, magnetic field perturconvection in the high latitude loneshers. We observe that in general, aspects field perturbations extend throughout the regions of gradients in the plasma convection, particularly squatorward of the plasma convection to the regions of gradients in the plasma convection to the study of 13 dayside polar passes shows that the Region 7 FACs (itims and Potenta, 1976s) are observed to span the convection reversal and extend an everage of 0.5° invariant latitude polested of the reversal. Region 11 currents are observed entirely on sunverd convecting plasma. Simultaneous observations of low snergy electron data (200 ev-25 kew) indicate that the polested last of the Region 7 FAGs is nearly coincident with the high latitude limit of 1 kew plasma wheet electrons. These observations are consistent with a model is which the dayside Region 1 FAGs have a source that is at least partially due to a "viscous-like" interaction on closed field lines is the low latitude magnetospheria boundary layer.

J. Geophys. Res.. Blue. Facer 160189

5530 Righ-Latitude immemberio currents
FIELD-Aldean CLERENTS AN ELECTRIC FIELDS
CRESHED IN THE FRAINC OF THE DAYSHE CLEP
M.A. Doyle (Regis College Sessanch Center, Neptun,
MA), F.J. Rich, W.J. Burks and M. Balddy
Thirteen passes of the 53-2 sabellite, spring
instelly along the monosidalght paridies, during
instelly along the monosidalght paridies, during
lansany, 1976 through the region of the dayside
comp have been studied: sight in the northern
hamisphere and five in the southern headsphere.
For all passes the IPF 3, 10 and for all but
three passes F₀ 1.3- indicating relatively odist
three. Experimentor of the sept-west deponds of
High-magnetic finald definentions indicates an extra
current, sheet, located polesand of region l'and
partyling current, in the opposite sense, on the
Figure of the current parising the current prepoor (fort-form) side in the northern (southern)
had a proposite and the convention electric
three propositions in the convention electric
three propositions reversals occur 2-19 equa-

toward of the boundary between this extra current sheet and the region I field-eligned current sheet. A boundary marking the transition from quasi-trapped to untrapped 100 keV protons as determined. The extra field-eligned current sheet lies almost entirely poleward of this transition boundary suggesting that it may lie in a region of open magnetic field lines. Pine scale structure of the magnetic field lines. Pine scale structure of the magnetic effections indicates summons field-eligned sheet and line currents embedded in the large scale field-eligned currents sheets. (Dayside cusp, field-eligned currents, electric fields).

5530 Winds and equatorial electrojet REGORT AND LATTEUDE STRUCTURES OF RECU-TRIO FIELD AND CURRENTE DUE TO LOCAL EAST-TRIC WINDS IN THE EQUATORIAL ELEC-FROM PIECE VINDS IN THE EQUATORIAL ELECTROWS
G.A. Reddy (Vikram Sarabhai Space
Gante, Trivandrum 695022, India) and
G.A. Reddy (Vikram Sarabhai Space
Gante, Trivandrum 695022, India) and
G.Y. Devasia
Using the equivalent electrical circuit
method, the height and latitude structures
of the electric fields and currents generated by shearing east-west winds have
been computed theoretically. The polarisation electric fields, the transverse
currents in the magnetic meridional
plans and the east-west currents generated by a variety of wind structures
are presented to show their height
structures and the latitude range of
00 to 9°. In addition, the latitude
structure of ground-level magnetic
field perturbations due to wind-generated currents are also presented.
The results are discussed in relation
to the observed characteristics of the
equatorial electrojet like the day-today variability of its latitude
structure and observed distortions of
the height structure. The implications of the theoretical results with
regard to the plassa dynamics in the
equatorial E and F regions are also
discussed.
Geebbas, Mes., Shue, Facer SOALSOO

Geophys. Res., Blue, Paper 80A1800

5535 interactions between waves and particles THE EFFECTS OF ELECTRON-NEUTRAL COLLISIONS ON THE INTENSITY OF PLASMA

A. L. Nawman (The Assessment Corporation, A6/ 2417, Box 92937, Los Angeles, California, 98009) A. L. Newman (1se Astrospace Corporation, A6/2417, 80s 29397, Los Angeles, California, 90009) and E. S. Oran
In his sarth's iomosphere the presence of non-thermal electrons causes enhancement of the electron plasma line resonance observed by incoherent backscatter radar. This paper extends previous calculations of the plasma intensity by including resonance breadening due to electron neutral collisions. A BCK collision term is included in the derivation of the electron spectral density function obtained from Fluctuation Dissipation theory. Assuming the nonthermal electron distribution is a small perturbation on a Maxwellian distribution of background electrons, the expression describing the signal intensity for a plasma line reduces to the form obtained previously when only electron-ion collisions were included. Results of this extended model are compared to recent measurements made with the Chataniks radar.

J. Geophys. Ras., Blue, Paper 8041637 J. Geophys. Ren., Blue, Paper SOA1637

5340 los densities and temperatures ELEVATED ELECTRON TEMPERATURES IN THE AURORAL E

SIMO ION DENETIES AND TEMPERATURES IN THE AURORAL E LAYER PRESURED UTIL THE CRATAMIKA RADAR V. B. Wicker (Div. of Atmospheric Sciences. NSF, Washington D.C. 20550) C. Lathuillere, W. kofmen and G. Latume

An extensive series of spectral messurements has been made in the auroral E region with the Chatatis Inchestent Scatter Radar. Because of the scalls leader and for he surroral E region with the Chatatis Inchestent Scatter Radar. Because of the scalls leader and for he waste seems of the scall seate length For variations of electron density, temperatures, and ion-neutral collisions we used the operating mode with the best possible range resolution-9 km. About 5% of the close the data exhibited an unusual apacteral shape that was cost pronounced at 105 and 110 km. Instead of being since Gaussian with only a small hint of two peaks, the spectra are much wider, with two well-developed peaks. After carefully considering the validity of the measurements and their interpretation, we conclude that the unusual apacter at due to greatly enhanced electron temperatures. At 110 km, the electron temperature may increase from 250 K to 300 K while the lon temperature required to the electron temperature and the state of the electron temperature actume of for by auroral particle presipitation, though it colneides in time with ion-temperature anthencements of the electron temperature anthencements are solitated to be due to joule heating, we deduce that electric fields of 24 to 40 mV/m are present and that the sinctrons are moving through the long and mastrels at speeds of 500 to 800 m/s. Despite the electron electron camparatures are discussed. One is that the rate constants for molecular recombination are reduced. Another is that, during particle of significant jouls heating, the deduced electron despitatures. Several consequences of the alexators electron camparatures are made incitating to reduce a section of equal electron and iouismicion reces, and differential energy spectrs of spectral to account properly for the temper . Geophys. Res., Blue, Paper 1A0077

5510 Low-lexitude Longsphoric currents RICHOPATE EQUATORIAL SCHTTILLATION INTERSITY DURING THE CHEMIT SOLAR MAXIMUM J. ASTON CHEMIT SOLAR MAXIMUM Manacom ATB, HA 01731) H. Whitney, H. MacKengie and S. Rew.

is narous(Air Roces Geophysics Laborstory, issuecos APP, MA 01731) R. Whitney, R. Hackansia and S. Rass.

A comparison of acintilistion levels at 1,5 GHz sade from the summaly region of the magnetic squater and from the ragion close to the magnetic squater (termed the electrojet latitudes) blowed increased F region irregularity intensity over the amously region during years of high summaps number. Feak to pask fading greater than 27 des noted from Ameenaion Leland (through a dip latitude of 17°) in the smootly region while only 2-9 dB from Matal, Brawil and Hannagon, Paru were noted, the lest two paths close to the magnetic aquator. The hypothesis advanced in that the dominant factor responsible for the intranag gigsherits scientilision at the traversal of the propagation path through the amountly region. During years of high simmpor numbers the high lavels of AN countifuling the P region irregularity structura are due to (1) Very high electron demaity in regions as (2) that late appearance of these high alectron densities (to 2200 LT) in the Romaly region. The patches or plumes of provide them, produces high AN; scintiliation accuraious are proportious; to this parameter. The postularion of vertical irregularity sheets in the difference between alactrojst and anountly the sumper markers years of 1969-1970 were colored and somety the sumper markers. Older signers that from the studies were also reviewed. It was found that through the amountly region high abstraling of the propagation path achartythos from the strengt markers. A son complete evaluation of the assemble path along in description, which assemble superiance is a path chosely aligned with the assemble partiality in detarphing, the shoulet walker of the adoption is descripting, the shoulet walker of the propagation path of the propagation of the propagation of the propagation of the source of the second of the propagation path echanter of the adoption.

Particles and Fields— Magnetosphere

5705 Bow shock waves
A STATISTICAL SURVEY OF IONS OBSERVED UPSIREAM OF
THE EARTH'S 80M SMOCK: EMERGY SPECTRA, COMPOSITION, AND SPATIAL VARIATION
F. M. Ipavich (Dapt. of Physics and Astronomy,
University of Maryland, College Park, ND 20742)
A. B. Galvin, G. Gloectler, M. Scholer and D.
Howestadt

A. B. Salvin, G. Gloectler, M. Scholer and D. Howestadt
The characteristics of 33 diffuse particle events in the energy range from ~30 to ~130 faV/0 observed upstream of the earth's bow shock have been determined. The measurements were made with the Ultra Low Energy Charge Analyzer (ULECA) sensor of the Nex-Planck Institut/Univarsity of Maryland instrument on ISEE-1. The energy spectre of these events are clearly steeper than power law and are generally well teacribed by either an exponential or Maxwellian in energy part charge, with average e-folding values of ~20 keV/0 and .15 keV/0, respectively. The composition in these events is remarkably constant as a function of energy per charge and is stellar (within a factor of ~2) to that of the solar wind. The particle flux is found to decay exponentially with distance from the bow shock, with an e-folding distance of ~7 Re for H and He at 30 keV/0. Inverse velocity dispersion was observed in each event, with an average delay time of ~40 min, between the 30 keV and 130 keV proton equilibrium intensity levels. Our measurements are consistent with a Fermi occeleration mechanism and the presence of a free escape boundary upstream of the bow shock. (Upstream particles, Fermi acceleration. Composition.) Composition.) 1. Coophys. Res., Blue Paper 8041814

BASINEMENTS OF BOY SHOCK PARTICLES FAR UPSTREAM FROM THE EARTH (Physics Department and Space Science Laboratory, University of California, Berkeley, CA 94720)

Electrons and ions moving upstream frequently appear at distances up to 240 Rg from Earth at times when the direction of the interplanetary magnatic field allows their propagation from the bow shock. Strong asymmetries in the ion angular pitch angle distribution are often observed, a consequence of the sharp gradient in guiding center density and very weak scattering. The gradient is due to the restricted spatial region over which these particles are accelerated. The solar wind electric field, E = ½ 8 Mg facts on these particles and produces & frifing effects in both the ion angular distrigutions and the ion energy spactra.

J. Geophys. Res., Blue, Paper 140020

S705 Bow shock waves
CORRELATED WAVE AND PARTICLE OBSERVATIONS UPSTREAM
OF THE EASTH'S BOW SHOCK
C.C. Herway (Observatoirs de Paris, 92190 Meudon,
France), K.B. Bavassano-Cattanag, K. Bobrowolay,
S. Orsint, A. Kangeney and C.T. Fussel'!

Bats from three ISEE experiments has been ansiyead during several periods of turbulence observed
in the solar wind upstream of the Earth's questparallel bow shock, Radio observations are used
to validate a shock model, which is subsequently
used to compute verious geometrical paramotors
during all the periods studied. One typical nine
hour period on 1977 Fovember h is discussed in
some detail to lilustrate the parameters atudied
and the correlations found. It is shown that,
during this period, the radio noise spectrum hus
two components, one centered mest the local electron plasms frequencies; the latter component has a
shorter wavelength and correlates with the level
of m.h.d. turbulence. A multivariate canonical
statistical analysis of perticle and m.h.d. data
during a two week period shows that the proton
sminotropy and turbulence level correlate wall
with the minimum backstreaming proton parallel
velocity pmig which, as defined here, is a pureity geometrical parameter. Triveriate analysis
shows that the correlation of particle and urbulance with the angle between the magnetic field
and the shock normal have their sense reversad
when allowance is made for the strong correlations
with pain. A very good correlation has been
found between power and compressibility in sagnaric flactuations. (foreshock, turbulence).
J. Geophys. Rea., Blue, Paper 140158

5715 Electric Fields
DOUBLE LAYERS AND ELECTROSTATIC SECCES
Noah Hershkowicz (Department of Astro-Geophysics,
University of Colorado, Boulder, Colorado 80109)
It is shown that it is useful to define double
leyers and shocks so that the lon phase spaces of
double layers are shown to be just the wirror
image (shout sero ion velocity) of the lon phase
epaces for Laminar electrostatic shocks. The
distinguishing feature is the direction of the
free ion velocity. It is also shown that double
layers can exist without the presence of trapped
ions. The Bohm condition for double layers,
that the ion drift velocity on the high potential
aids must be greater than the jon cound velocity,
is shown to be related to a requirement of a
lower limit on the Mach number of median
electrostatic shoots. (double layers, electrostatic shoots)
J. Geophyn, Res., Slue, Paper 140192

5720 Interactions between solar wind and mag-natosphere UPSTMEAN WAVES AND PARTICLES: AN OVERVIEW OF THE ISER RESULTS Bruce T. Teurutani (Jac Propulation Laboratory, 4800 Oak Orove Drive, Pasadena, CA 91103) Paul Rodrieum A000 Oak Orows Drive, Pasadena, CA 91101) Paul Rodriguer
This issue contains results presented at the Upstream Vava and Farticle Workshop hald at the Jat Propulsion Laboratory, California institute of Technology, Pasadena, California on 15-16 April, 1980. This overview article summarises the results of the collective ISEZ work. Several critical scientific problems remaining to be solved are manifound with the hope that readers may be sufficiently aroused to attempt to study/solve them. In conclusion, some obvious astrophysical implications are discussed. discussed. J. Geophys. Rev., Blue, Paper 1AG188

DISAPPEARING SOLAR FILAMENYS: A USEFUE PREDICTOR OF GEOMARNETIC ACTIVITY

J. A. Joselyn (National Oceanic & Atmospheric Administration, Environmental Research Laboratories, Space Environment Laboratory, Boulder, Colorado BOSO3) P. S. Melntash
Disappearing solar filaments have long been suspected as an indicator of terretrial magnetic disturbances. However, because filament disappearances are a common solar event and because they failed as a condidate source for Mercagion (recurrent) magnetic disturbances, their potential utility as a forecasting aid for geomagnetic atorns has largely been maglected. A search for possible solar sources of geomagnetic atorns from June 1976 through June 1979 has revealed that a significant number of the storns, including the two largest, can only be associated with filament disappearances. This result is supported by the many recent papers studying SKILAR and other observations of cordual transjents taich always find a storng correlation between those transients and eruptive prominences. By enalyzing the physical characteristics of those disappearances which precede magnetic storns and those which do not, some tentative guidelines for forecasting decompantic distributors have been developed based on evidence of a significant restructuring of the implication of a significant restructuring of the implication of the significant restructuring of the significant restructuring of the implication of the significant restructuring of the significant re sprth. Geoghys, Res., Blue, Paper 140199

5750 Plasma cotton, converting, or disculation CROUND-BASED OBSERVATIONS OF THE LO TORUS DURING VOYAGER | EXCOUNTER: INDICATIONS OF EMBAGGED PLASMA INSECTION AND TRANSPORT PLANA INICTION AND TRANSPORT
A. Eviator Uspartness of Atrospheric Sciences.
Latversity of California, Los Angaies, CA 90024;
Y. Hakler, N. Brosch and T. Mazah
Ground-based spactroscopic observations of
the cold to torus mido before, during and after
the Voyager 1 encounter are compared to the
published spacecraft data. During the encounter
itable methor accluse nor sulfur colscions were
detacted. The implications of this finding
for the injection sod transport of playes are
sussessed. (to torus, Voyagar encounter,
optical spectroscopy.)
Gaophys. Ros. Lett., Paper 11.0136

2760 Plasms motion, convection or circulation PRODUCTION AND TRANSPORT OF 0° IN THE IONO-SPHERE AND PLASMASPEERE

J. Gelss and D.T. Yaung (Physikalisches institut, University of Barn, 1012 Barn, Switzerland)

The abundance of 0° 10° has been observed to reach values of unity and above in the equatorial plasmasphere at L.J. This is two to three orders of magnitude greater than the relative 0° abundance at corresponding latitudes in the topside isnosphere. In this paper we pursue our sarifer angagastion that thermal diffusion of 0° 4 friven by the temperature gradiant between the imposphere and equatorial plasmasphere, is responsible. We have carried out this study by meserically integrating the time dependent diffusion equation for equinex conditions. Becaut plasmaspheric data from the GEOS-1 spacecraft have been incorporated into a realistic model of the traperature and destities of major ion species autonding from the ionosphere to the equatorial plane. Convection as well as local time variations and details of ion chemistry have been included in the model.

Our main conclusion is that only thermal diffusion can account for observations of 0° 70° 1 in the equatorial plasmasphere. Furthermore, we have found that there is a threshold temperature gradient between ionosphere and equatorial temperature at 1.2 of 2.000 K, below which thermal diffusion becomes ineffective.

J. Googhya. Res., Blue, Paper 80A1819

J. Goophys. Res., Blue, Paper BOA(819

5760 Plasma motion, convection, or circulation LOW-ENERGY ION PITCH-ANGLE DISTRIBUTIONS IN THE OUTER MAGNETOSPHERE. ION AIPPER DISTRIBUTIONS

J. F. Fennul, D. R. Creley, Jr. (both at: Space Sciences Laloratory, The Aerospace Corporation, P. O. Hen 92:977, Los Angules, CA 70009) and S. M. Kaye

lon pitch-angle distributions, measured in a near synchronous orbit, are predominantly field-aligned at low energies and predominantly peaked perpendicular to the magnetic field at higher energies. The transition from field-aligned fluxes to fluxes peaked predominantly perpendicular to the magnetic field occurs over a very narrow energy range. These ion distributions have been observed at all local times between 5, JR, and 7, 8 Pg. This transition energy correlates with the deep minimum observed in the lon sporter. There is no apparent correlation between the ion transition energy and magnetic local time. L. Ep. or Dat. However, the iransition energy does reapond to unserved particle injections. The transition energy decreases prior to injection, increases alreapily all injection by as much as 10 to 20 keV and then decreases in intensity over several hours to instrument threshold level. Ion drift trajectory calculations indicate that the low-energy component above the transition energy drifts in from the night-ride plasma sheet via local morading to the day side, The Ingle-ergy, component, above, the transition energy, arrives on the day side via local evening. Hone, Paper 140142

5770 Short period (less than I day) warfetions of magnetic field CMARGED PARTICLE BEHAVIOR IN LOW FREQUENCY GEOMAGNETIC PULSATIONS: 1. TRAMSVERSE MAVES D. J. Southwood (Department of Earth and Space Sciences, University of California, Los Angeles, Los Angeles, Charged particles in low frequency geomagnetic pulsations is exemined with particular emphasis on what a spacecraft-borne detactor would observe. We concentrate on the effects of purely transverse electromagnetic signals. The time scale of a particle's motion relative to the wave period is shown to determine the nature of its response. For low energy particles, the acceleration in that matters. At higher energies, what has occurred over recent bounce and drift motions becomes increasingly important and convection of gradients by the wave § x B drift must be considered. Oistingsishing features such as phase differences between signals in back-to-beck detectors or between channels of different energy are catalogued. In particular, we assess the detectability of resonance effects in the light of detactor characteristics and finite signal bandwidth. Recent observations are used to illustrate the idea developed.

J. Geophys. Res., Blue, Paper Al0100

7770 Short-pariod (lass than I day) watistions of magnetic field
DISTRIBUTION OF AMPLITURES OF GEOMAGNETIC VARIATIOMS AND RELATIONSHIPS TO THE K ISDEX
M. Kane (Mail Laboratorias, Marray Mill, M.J.
07974), L. J. Langenotti and C. G. Manisaman
Ms study to this brief report the properties
of sepirical casulative distribution functions
of geomagnetic signals measured at three hour
intervals for two separats one-month pariods at
three existions spends in latitude from LeJ.2 to
144,0. The completive distributions are also
compared to theoratical casulative distributions
The widths and sepiritudes of the sepirical
distributions, as well as their deviations from
Geomagnet, are studied and compared to the global
and "local" (in longitude) geomagnetic Findicae.
In general, the widths of the sepirical distributions become breader with increasing geomagnetic
activity; the widths of the delitibutions are
parrower at lower latitudes for a given level
suspectic activity. Many engirical casulative
distribution inscitions compare favorably to the
theoretical functions! deviations show no telestion
to suppostic power spectra).

J. Geophys. Res., Blue, Paper 1A0097

IND. Wave propegation
THE SPECT OF MICROSCOPIC THESULENCE OR
MAGNETOFFREE-INMOFFREE COUPLING
R. L. Lysek and C. W. Carlon (Space Sciences Laboratory, University of California, Berkelay,
CA 94720)
The effect of turbulence on the coupling of the
magnetosphere and ionosphere has been investiasted by including an affective collision
frequency in the slectron equation of motion.
When this term is combined with the continuity
squation, the ine equation of motion and
Marwell's equations, a Alaparation relation for
the kinetic Airfew over including affective
collisions is found. The Marwe-particle interaction leads to a strong damping of the wave.
Inclusion of the affects of places sheet justice
yields a scale him transverse to the magnetic
field which corresponds to the mise of visual
autoral acts. eurorel arts. Geophys. Res. Lett., Paper 110137

Planetology

SPECIFICACETY OF THE CAMERON BANGS IN THE MARC AIRCLEM R. B. Corney (LASF, Univ. of CO, Compus Rox 392, Boulder, CO 80309)

Mars singles spectra sequired by the ultraviolet spectrounter experiment of Mariner 9 services spectrounter experiment and the interpolation on the last two brightest features between 1800 and 2600 a in the observation of allitudes between 88 and 1800 and 200 a in the observation of allitudes between 88 and 1800 and the armonist control to characterized by any single rotational temperature but in bont described by temperatures of 1600 K for lower J values and 10,000 K for higher J values. The first negative bands of CO are not identified in the residual spectra. The observed sentth intensity of the Campron bands is 16.7 kR and is in good agreement with a theory with electronings of disconlation as the next important excitation sectanism. The observations suggest the value of the cross, seei on for this process should be 7 x 10-17 cm².

J. Geophys. Bea., Blue, Paper 140016

6510 Atmospheres of planets
10% TEMPERATURE ANISOTROPY AND HEAT FLOW IN THE
VENUS LOWER LOWSPHEER
R.W. Schuck (Center for Atmospheric and Space
Sciences, Utah State University, Logan, Utah
86122) and J.-P. Sc-Maurice
Mativated by the recest observations of supersonic fon flow in the Venus temosphere near the
terminator, we have studied the extent to which
such a flow can induce as lon temperature emisactropy and a diffusion-thermal host flow. Our
talculations indirect that approximate includes below about 220 km. The temperature
anisotropy is with respect to the for-neutral
relative drift velocity vector, with the fon
temperature parallel to the relative drift
velocity greater than the perpendicular lon
temperature ratio in likely to be in the range
of from 2-4, depending on the innospheric renditions. We have alson found that in the same
lonospheric region the ion-neutral relative
drift induces a diffusion-thermal heat fine
that the considerably more temperature than ordithat is considerably more important then ordi-mary ten thereal conduction. Immosquently, diffusion-thereal heat flow could have an ap-proctable offect on the ion emergy believe in the "enus lower lowesphere. J. G. ophys. Res., Blue, Paper 1A0227

of 10 Atmospheres of planets

Ny ABUNDANG IN THE ATMOSPHIRE OF VENUS

S. Runar, D.M. Hunten (Lunar and Planetary Laboratory, University of Arizona, Lucaon, Arizona 8572)) B.A. Taylor, Jr.

The in situ desputedents from the Planet Yenus Orbiter (Prio) lan Haws Spectrometer have led to the detaction of Ny tone in the Venus Somosphere. Although Ny tone in the Venus Somosphere. Although Ny tone in the Venus Somosphere. Although Ny tone in the upper atendants of Young. A photophocical codel using PVO beasurements is used to derive an Ny chain ratio of 10 pur teles 10 ha miritude. The presence of this ruch Ny continue or of vith Ny and subsequent theoretication of Olf provide an important source of nontherest H observed in the Venus escaphere. The restituted enterpe line for H is 100 cm⁻² p⁻¹, (Venus, deronces, immospheres)

4510 Atmosphere of planets AUROPA IN JUPITER'S ATMOSPHERE? AUFOCOA IN INTER'S MINISTREE.

A.F. Cook II, A. Vallance Jones and
D.E. Shemonky (Earth and Space Sciences
Institute, University of Southern
Cilifornia, Tuckon Laboratories, Tuckon,
AZ 85/13

The darkside limb pictures obtained by the imaging experiment on Voyager 1 have been recessioned. It is concluded that the observed luminosity is very likely due at least in part to lo torus surors. If the offective wavelength of the emission lies in the 4000 % to 5000 Å region, the slant intensity is estimated to be about 20 kg. The observed double attucture tay be due to a number of causes such as horizontal atructure in auroral entasion, aurora plus twilight or photochemical airglow plus autora. (aurora, Jupiter, (maging). J. Geophys. Res., Blue, Paper 140073

ORIGIN OF NARTIAN OUTFLOW CHANNELS: THE EOLIAN HYFOTHESTS

J.A. Cutts (Planetary Science Institute, Science Applications, Inc., 281 S. Lake Ave., Suite 218 Passdens, CA 91181) K.R. Blasius

The ancient outflow channels on Hars exhibit fossil flow patterns similar to current flow patterns in torrestrial desert regions eroded by wind. Me have modelled outflow channel formation by a cascade process in which sand-sixed particles produced by rock weathering in the chaotic terrain "source areas" of the outflow channels were transported by the wind sorous the adjacent plateau surfaces sand bleating and deflating the surface. Comparisons of model predictions with photogeologic data suggest that rates of rock breakdown by physical and chemical action along the channels during the channel forming era must have been on with higher they have been on similar terrains formed after the channel era ended. A tenuous atmosphere, comparable to the present one, could have transported materials sufficiently xapidly to excevate outflow channels in about 105 years. Nowever, there may be difficulties in emplaining how abrading particles could auvules higher there may be difficulties in explaining how abrading particles could survive high velocity impacts in a thin sencephere over the many hundreds or even thousands of kilometers that they were transported in outflow channels. It is difficult to affecting rock breakdown rates, atmos-pheric density, or both occurred early in martian history to end the era of outflow channel formation. Particulate materials genorated during this era may be important components of the north circumpolar dune field and the polar inyered deposits. (Hars, channels, grosion, climate, wind), J. Geophys. Res., Red. Paper 180021 effecting rock breakdown rates, atmos

6515 Surface of Planets ON THE CALLEAN CONDITATES OF PERTURES OF THE CALLEAN SATURITIES IN. E. Davies (The Rand Corporation, Santa Monice, California 1906) and F. Y. Estayana Cantrol mets of the four Callians satellitus have been established shortgrammatrically from pictures than by the her Voyager membersel; during their flykys of Jupiter in 1979. Coardinates of 504 points on Enropa. 1547 points on Canyanda, and 439 points on Callisto are listed. Beleated points are identified on 1250 mays of the establians. Hearn-remeats of thems. points were made on 234 pictures of Gauyanda, and 200 pictures of Estaya. 282 pictures of Gauyanda, and 200 pictures of Callisto. The Systems of Loagitude were defined by creaters on Europa, Canyanda, and Callisto. Frailianary solutions to trouble of the Gailean astellities. Her men refit have been found for the directions of the arms of rotation of the Gailean astellities. Her men refit have been found for callisto. (Callisto, Callisto, Gailean astellities, Garanda, and 200 to 10 km for Callisto. (Callisto, Goodinate, coordinate).

J. Couplys, 123., Red, Paper SCRIGIO

1000

. .

i nath

Particles and Fields— Interplanetary Space

5110 Germin 1995
144 Propriation of Low Entrol Project Distri-billion of Foregoriths, Interface their Market A White A Short Short Albert A White Call Structure of the Control of the Co enter a variation springlying to Be Decker (Applied trystem Interatory, The Libra dipates Inderestes, Incret, Mis., 20010) - Conserted aboutstice has been developed to A nevertical similation has been developed to atoms the forestion in the intensities of the first the forestions of the long-lived dearmitte atom particle (bif) needs observed to association with the immorph of flare-produced feat-onde 900 shicks. Protons are traced constrainty takes in the first determin, through their adiabatic nester-free rotten nions the associal instead of 197, or finally through the shock discontinuity to their pre-shock intensection state. An arbitant proton on understant state on the contensity desired on the first action of the contensity of the pre-shock of the contensity of the pre-shock of the contensity at the contensity of the contensity o assumed lander aging [18], and finally through the shock discontinuity to their pre-shock-litereration state. An arbitant proton on anderer at not one shock encounter during which, as seen in the shock frame, the grown is declarated by the affective "grain-bright" along the induced electric field each them is prosone the shock. The blue-reverse? calculation reveals which of the observed protons interacted which the house the shock of the observed and by how much each interaction protons by low much each interaction protons between the shock interaction protons for explication of the undifferentiable and untilized them for the proton for each first first of the shock in a content of the proton for a first first of the shock of the undifferent and the special enjoying point for any first flower are forced for a first point of the first proton of the shock means of an arrending the shock means for different advanced proton contributed and and arrending the shock means and an arrending the shock means and an arrending the shock means and an arrending the shock means and the shock to file and the shock arrives and the shock to file and the shock arrives and the shock to file and the shock arrives and the shock to file and the shock arrives and the shock to file and the shock arrives and the shock to file and the shock arrives and the shock arrives and shock arriv Burney St. C. Box of Phys. Letter (1901) 8.

Control of the Deliver type of the Dip Professional Control of the Deliver type of the Dip Professional Control of the Deliver type of the Deliver

The state of the s To the second of the second of

The second secon becamian to realtly seen, to account for these

" Herships Res., Sive, Paper Scaliffe

COMMUNICAL EXPERIENCES FOR THE PROTECTION TRANSPORTED THE SOLAR WIND-Pintarin; San g. . . Petetek Consider Section Cobin, 188,

to late the control of the Cormany of the common process of the common process of the common process of the common process of the control of these were decreased from the simplified Rachine-burnets well with the properties of the significant of the

5340 Shook waves

81-DIRECTIONAL STREAMING OF SOLAR WIND ELECTRONS

.80 of yight Evidence for a closed-field structure within the outyer day of all interplanting shoot

9. J. Base', ft-9. KS 435. Los Alexos Kational Laboratory, 164 Alexos, NK 87545) J. R. Isbridge,

W. C. Feldmin, J. T. Goeling, and R. D. Zwickl

In mear time colhosidence with the arrival of halium enriched plasming driving the shook wave disturbance of November 12-13, 1978, strong bidirectional streaming of selar wind electrons >-80 eV was observed with Los Alexon instrumentation on ISER 3. The shipping perayibed for many hours aimultaneously payaging any enriched for many hours aimultaneously payaging and interplanetary singulated in the electron of bid-directional streaming clearly cannot be explained by field line connection to either the enrich's bow shock or the outward propagating interplanetary shock which passed ISER-3 v16 hours earlier. The event is best explained if the local interplanetary field was a part of either a magnetic bottle rooted at the sun or a disconnected loop propagating outward.

1360 Salar wint interactions with noon and planeta
"PSTPFAN PARTICIPT GREGOVED IN THE PARTY'S
PORPHING RECTO!
T. N. FARTHIN, R. R. Andereon, L. A. Frank
Peparthent of Physica and Astronome, (University
of Town, love City, Lowe 52/87) and G. X. Parts

Brood primarily on an extensive study of fully three-dimensional plasma data, we describe the interrelationational plasma data, we describe the interrelationational plasma data, we describe the interrelationation of the unstream particles and plasma waves observed in the earth's foreshock reation. The University of fews LPPPORM detections and electrons from 1 eV to 45 keV over all except - 27 of the unit sphere. Proportions are safe with high time resolution particle data obtained by the University of California (Revieley) internance and plasma wave data collected by the University of California (Revieley) internance and lost plasma wave data collected by the University of California (Serbeley) international of the presence of ion bears and dispersional particles in the presence of ion bears are dispersed in distributions within plasma waves that lon-accustic estimation to enhanced when increased unlead-regions and grouphose magnification of well-city distributions taken within the foreshock trailing effects limit the interpretation of well-city distributions taken within the foreshock trailing. Wigh they readuation control of the production of the time variations of a stable interest, demonstrate that time variations of a stable interest, demonstrate that time variations, between the interpretation of the first productions. of a wrible instepte or anisotropic distributions of a wrible instepte or anisotropic distributions cannot produce the dispersed in distributions. Detailed analysis of high time resolution data recesses that the supercent patticles underso significant spatial and semporal waristines including switches organization. Graphase organization. Graphase organization of contact reach rise of which includes how with shelling sixth angles that greats regether should account and adding leasts. Send on our high-time resolution activity of fails three diseasements in activities of fails three diseasements in least offer a combined with regeneric field and places were data, on find that (1) has observed in the formation region displaces with a spatial scale of the send of the fails of the clusters with a spatial scale of the send of the fail and offer in the fail of the f

5370 Solar wind magnetic fields INF Enhancements Associated with Streams; An Analysis of the Magnetic Field 2. Villante (Estituto Fisico, Università,

L'Aquila). field behaviour in the field enhance-ront rogions associated with the high velocity stream fronts observed during the primary mission of Melios 2 (January terough April, 1976). The principal conclusions of our investigation are the following: a) The relative variation of the field magnitude ranges between 1.3 and 1.8 and is independent of heliocentric distance at least between 0.5 and 1 AU; b) Close to the sector boundaries the field enhancements are constituted. the field enhancements are consistent that field perturbation occurring in a plane perpendicular to both the solar equator and the radial direction; c) the field line has occasionally the form of a cylindrical halix rather than a simple planar georetry; d) there is no consistent of the field line has occasionally the form of a cylindrical halix rather than a simple planar georetry; d) there is no consistent of the field line of the field li planar geo-etry; d) There is no compl-ling evidence to relate, in the inner tolar System and in the period of interear, the field enhancements with the shipe and location of the sector boundiry surface. J. Teophys. Res., Plus, Paper 110106

5360 Solar Wind Playra LPJIRTAM PADTICLE SPATIAL GRADIENTS AND PLASMA MAYS

5. h. Fares (University of Mashington, Seattle, athington), E. Greenstatt, C.S. Ma, C.S. Lin, A. Strarc, R.P. Lin, M.A. Anderson, C. Gurgiolo, E. Strarc, R.P. Lin, M.A. Anderson, C. Gurgiolo, E. Mash, P. Rose, B. Anderson and T. Esthan The wistrean electron and for fluors datacted by can excernent on ISEE 1/2 spacecaft undergo fraction time variations, from a few seconds to minutes. Many flux variations correlate with directional changes of the interplanetary magnetic field (1997). Particles propagating in the upstern region acts on by the solar wind electric field creates a quest-stationary particle patterns in true. Estemily, the spatiarial fraquently crosses the bounismies of these particle patterns for the particle patterns. Car analysis strongly sucpass that the carticle line irrelations are usually statial variations that have ten Consoluted into our data. Estimates of the Thickness of the particle boundaries dead at 1 Larmer radius for both the upstream electron and ion events). Plasma makes are clumped in association with the upstream larticle films and a correlation between the authorized and the particle boundaries is accounted in association with the upstream larticle films and a correlation between the authorized and the particle boundaries is 1,000 to 1 and CFSTREAM PARTICLE SPATIAL GRADIENTS AND PLASMA

Sign Salar Wind Plasma
MANI PONTEADPHANIC INTERACTION OF MICH SPEED
STRANG
Y.C. Whang (Catholic University of America,
Washington, D.C. 2006) and T.M. Chien
Manuteal Industrons of magnatuhydeodynamic squations are carried out to describe the nonlinear
interaction of correcting high-speed itemas near
the tolar squatorial plane. The problems are stusied. The first problem is to almulate the endution of an idealized high-speed stream. Murerical
advaluence are obtained to represent the seriations of filtor stockity, magnetic field, plasme
dentity, comparature and conduction heat five in
the interaction region. They demonstrate that
the thermal structure of a high-speed stream is
denicated by the dynamical interaction and heat
conduction process. The section problem deals
with the formation of correcting shock where
there the fausting adge of a broad stream resulting from the myring of characteristic curvat.
Correcting Stocks, analys. (Correcting Stream),
deponding shocks,
Geophys. See., Stee, Paper 204181) Coroleling Stocker. J. Geophys. See., Blee, Paper Bigger)

5320 Solar wind plasma ACA-EXB GRIENED ICH HEARS UPSTREAM OF THE EARTH'S

SALEAB GREED IGN HARS UPSTREAM OF THE LARTH'S BM LICES

SALEAB GREED IGN HARS UPSTREAM OF THE LARTH'S BM LICES

C. duritolo (University of teshington, Space Sciences Division, Geophysics Program, Seattle, WA 38195) G. K. Parks, B. H. Kank, C. S. Lin, K. A. Anderson, R. F. Lin, and H. Sene

The unorpointed appearance of spin modulations in our fixed voltage electrostatic analyzer detectors on LEZ L/2 has given us the opportunity to investigate the pleama proparaties of the upstream ions in high time resolution. The detectors are marvolly collinated and point southward, antiparallel to the satellite spin main covering a region in passe space not viewed by the other pleama experiments on the satellites. The count rate modulations (up to three orders of ragnitude) are due to the covolution of the anisotropic detector response function with the local pleama distribution function, by assuming a form for this distribution function. By assuming a form for this distribution function, he can simulated and observed count rates, we can then estimate several of the local pleams paramaters. This, of course, is dependent upon the distribution function chosen. Using an isotropic "Floring" Examplifican distribution with the hought of as a "local" approximation to the actual distribution near the region in phase space occupied by our detector response functions), we have obtained estimates of the local pleama temperature and three-dimensional Tow velocity of the upstream inn population to the actual distribution mark in propositional Tow velocity of the upstream inn population in the local pleama temperature and three-dimensional Tow velocity of the upstream inn population in the local pleama temperature and three-dimensional Tow velocity of the upstream inn population in the local pleama temperature and three-dimensional Tow velocity of the upstream inn population in the local pleama temperature and three-dimensional Tow velocity of the upstream in population of upstream prices, there exists becamiliar lows with temperature in

5180 SOLAT WIND PLASMA
WAVE-ELECTRON INTERACTIONS IN THE HIGH SPEED
SOLAR WIND SOLAK Wiku S.J. Schwartz (Queen Mary College, Mile End Road, London El 485, Great Britain), W. C. Feldman and

J. Goophys. Res., Blue, Paper 140104

London El 48, Great Britain), W. C. Feldman and S. P. Gary
Ve investigate the role of pleasma wave-patticle interactions in modifying the electron velocity distributions of the high speed solar wind. Both electrontatic and electromagnetic fluctuations are considered. We find that interactions between thermal electrons and a small fraction of the observed wave apparent and assault fraction of the observed wave spectrum provide a momentum exchange rate strong enough to compete with ' Coulomb collisions. (Interactions, solar vind). d. Goophys. Res., Blue, Paper LA0155 the observed vive spectrum pro-

Particles and Fields lonosphere

5305 Airaico
SINULTALECTS OBSERVATIONS OF OI 7774 Å AND [OI]
6200 Å EMISSIONS AND COMPLATHER STUDY WITH
10000 PID PIC PARAMETERS
1. Sahiaf, J.A. Bictuncourt, H.R. Telmeira and
1. Takaira hi (Inactitud de Pesquiana Espaciais,
Conseito Nacional de Deservalvimento Científico
c Icciológico, 1200 São José dos Campos, S.P.,
67411)

President measurements of the 01 1774 Å and [01]
Peggian measurements of the 01 1774 Å and [01]
Peggian measurements of the 01 1774 Å and [01]
Peggian measurements of the 01 1774 Å and [01]
Peggian measurements of the 01 1774 Å and only only only on the old of April 1978 to March 1979.
An iotassand is also operated at Cachusira Paulista. A correlative study of the 01 1774 Å and [01] of 190 Å existion observations, with almutaneous ionosonis measurements, shows good carrelations between 1377,117 and Y-layer took electron density (n (e)), and between the ratio (1-yn,1)17 / (1/3)10 and the height of the F-layer (1-yn,1)17 / (1/3)10 and the height of the column emissions rates for the 01 1774 Å and [01] 6300 Å colsions, respectively. Simultaneous measurements of these two outsalons would be a very useful technique for recorse aeming of the ionospheric F-layer dynamics. (01 7774 Å, [01] 6300 Å, lonospheric paremeters).

J. Geophys. Res., Blue, Paper 80A1797 Geophys. Res., Blue, Paper 80A1797

1505 AIRRIGHT TO EMISSION DI THE TEPRESTRIAL SIGNICION DE THE TEPRESTRIAL

T. G. Stanger and D. L. Huestie (Molecular Physics Laboratory, SRI International, Maulo Park, CA 940259 Synthetic Spectra have been calculated incor-Synthetic spectre have been calculated incorporation three 0. scalesion systems, Air and Air Air and A

3303 Airglau ATLONS OF MEUTRAL IRON BOLESION IN TVI-OBSERVATIONS OF PRUTRAL REW Entosition in Intelligible Spectra,
C. A. Toplay (Space Physics Research Laboratory,
Dept. of Atmospheric and Oceanic Science, The
thisystatery of Nichtgan, Ann Arbor, MI 48109)
J. W. Martwether, Jr., J. C. G. Walker and J. D.
Marhaus.

Sill Asrovas

Polan Cap ACCI AFD UNE PLADMA SHEET

Chigg-1. Heag (Applied Physics Leboratory, The
Johns Mopkins University, Learni, Md., 20510)

This latter suggests that most of the sorelied 'polar cap area' with the sum-aligned
resion occurring during the quisascent magnetesphere are actually a part of discrete area in
the autoral oval as a consequence of the polaseries widening of be quist sorred oval. This
sequence is based on (1) e detailed examination of two mosts of DMSP electron precipitation of two mosts of DMSP electron precipitation data and alguitumeous autoral observations, (2) the observed widening in the
licities of the very high grounds precipilicities to the very high grounds precipilicities to the very high grounds precipilicities of the "polar day becomercace of the
con-aligned stre, and (3) the conjugate widening
all the quiet averact oval over both the northern
set the polar cap area; is discussed in
vind-capangatory-best understanding of the polar
George, New Polar day area; is discussed in
vind-capangatory-best interpreciping.

5515 Auroras
SPATIAL ASPECIS OF ELECTRON ENERGY DEGRADATION
IN ATOMIC OXYGEN
R. P. Singhal and A. E. S. Green (University
of Florida, Gainesville, Florida 1281)
Spatial (radial and longitudinal) yield
spectra for electron energy degradation in
atomic oxygen have been obtained using a Monte
Carlo method for 25 eV to 10 KeV incident
electrons. Four dimensional yield spectra
have been analytically represented in terms of
a modal containing three simple microplumas.
Na find that the scaled spatial yield spectra
for 0 is approximately the same as for Na,
This feature provides a basis for inferring
yield spectra for any atmosphere gas or mixture of gases. (Electron energy degredation),
J. Geophya. Res., Blue, Paper 1A0125

5515 Autorem
UPPER LIMITS FOR X-RAY AND ENERGETIC MEUTRAL
PARTICLE MMISSION PROM JUPITER; VOYAGER-I
RESULTS

PARTICLS RMISSION FROM JUPITER: VOYACER-IRSULTS
R. Kirsch (Max-Planck Institute for Astonomy, p3411 Katlanburg-Lindou 3, West Cermany
S. M. Krindgis (Applied Physics Laboratory/The
Johns Hopkins University, Laurel, Maryland
20810) J. W. Kohl and R. P. Fasth
The x-ray sensitivity of the lew energy proton
channels in the Low Energy Chargad Particle
(LECC) experiment and its directional measurements are used to determine whether x-rays from
Jupiter can be recognized as additional flux
above background as Voyager I approached the
plauet. Batween 210 and - 100 K, a statistically significant count rate was detected
which we interpret as x-rays and/or natural
particles. The usper limit for x-rays, related
to earth-based measurements is < 1.3 x 10"
photons/cm'sec keV in the energy rangs 14 to 31
keV. Such an x-ray flux leads to estimates of
pracipitating electron intensities over the
Jovian polar caps which are - 200 times larger
than observed electron fluxes in the lo plame
torus. The same upper limit, corresponds to < 4
x 10" neutral particles/cm'esc keV at 100 k,
distance from Jupiter. We favor the neutral
hypothesis, and estimate that it represents a
loss of 100 arous/sec, i.e., < 0.05% of the
atons generated by lo's volcanoss.
Geophys. Res. Lett., Fapex 80L1781

3515 AUROTES
AURORAL ARC ELECTROPYRAMIC PARAMETERS MEASURED BY
AE-C AND THE CHATANIKA RADAR
O. de la Besujardibre (SRI International,
333 Ravenswood Avenue, Menlo Park, Celifornie
94025) R. Vondrak, R. Meslis, W. Equeon, R.
Hoffman

94025) R. Vondrak, R. Haelle, W. Hauson, R. Hoffman
Auroral are electrodynamic parameters are studied using coordinated measurements between the AE-C satellite and the Chatanike rader. On January 4, 1978 the spaceraft twice crossed an east-west-sligned sureral are at widely spaced longitudes, apanning more than three bours in local time. The Chatanika rader was scanning to elevation at a magnetic longitude squidistant from the two AE-C crossings. The electric field pattern around this are was remarkably similar at the three longitudes. Equatorward of the arc, the morth-mouth field was very intense (<60 mV/s), whereas, poleward of the arc, it was small (~10 mV/s). The east-west field was small and almost constant across the arc. The same are was observed by the rader during about one hour, and this electric field pattern did not change, even though the arc location, intensity and width changed substantially. The ion and electron temperature variations around this are were also studied. For a given electric field the AE-C measured ion temperature was substantially difference for the arc crossings. This dissimilarity is attributed to differences in the F-ragion neutral wind at the two longitudes. We show that the electric field vertations are consistent with the swistence of polarization charges within the arc, even though the electric field vertation charges within the arc, even though the electric field, somether field in a conductivities, currents). J. Goophys. Ros., Slue, Paper 140214

5520 Electric fields
MEASUPEMENTS OF IOMOSPHERIC ELLCTRIC FIELD CONVECTION BY THE LONG-LINE TECHNIQUE
J.W. MacDougal! (Contre for Madio Science and
Faculty of Engineering Science, University of
Mestern Ontario, London, Canada N6A 3K7)
Ionospheric E v B convections are measured by
a new tachnique which uses satellite scintillations. The measurements are for an ionospheric
region centred on 19°M, 82°M geographic or 53°
invariant latitude. Results are presented for
spring aquinox 1980. Quiot condition eastward
convection drift is approximately Y₁ = -12 + 43 cns $\frac{2\pi}{24}$ (t - 13.4). During disturbed conditions

at nightime the westward convection becomes large and highly variable. The northward parpendicular E x B convection is approximately V_{In} $-5 + 13 \cos \frac{2\pi}{24}$ (t - 10.5) + 6 cos $\frac{2\pi}{24}$ (t - 11.5) m/s during quiet conditions. During disturbed conditions the semidiurnal component of the northward convection increases by about a factor of 3 and becomes larger than the diumal. (Electric fields, convection, trough, disturbances).

J. Geophys. Res., Blue, Paper 1A0185

3530 Righ-latitude ionospheric currents GBSERVATIONAL EVIDENCE FOR A BOUNDARY LAYER SOURCE OF DAYSIDE REGION I FIELD-ALIGNED Chib pure CURRENTS
F. F. Bythrow (Cunter for Space Sciences, Physics Program, thiv. of Toxas at Dellas, Richardson, TX 75080) R. A. Heelin, W. S. Hanson, R. A. Power and R. A. Hoffman
The addition of magnetic field measurements to the Atmosphere Explorer-C data base has enabled us to examine the relations between field-aligned currents (TAC), energetic particles and pleased convection in the high latitude ionesphere. We observe that in careal measure field exiturconvection in the high latitude ionesphere. He observe that in general, magnetic field parturbations extend throughout the regions of gradients in the planes convection, particularly equatorward the planes convection reversal. A study of 13 dayside polar passes shows that the Region 1 FMCs (141sm and Fotence, 1976s) are observed to apar the convection reversal and extend an average of 0.5° invariant latitude polesserd of the reversal. Region II currents are observed entirely on ourward convecting plasma. Simultaneous observations of low seargy electron data (200 ev/25 keV) indicate that the polesserd limit of the Region I FACs is nearly colocident with the high latitude limit of I keV plasma sheet electrons. Those observations are commistent with a model in which the dayside Region 1 FACs have a source that is at least partially due to a "viscous-like" interaction on closed field lines in the low latitude segnatoropheric boundary layer.

J. Goophys, Rea., Blue, Paner 140189

5330 High-latitude ionospheric currents
FIRID-Alicaso CURRENTS AND ELECTRIC FIELDS
GESCHAND IN THE REGION OF THE DAYSING CURP
M.A. Doyle (Regis College Research Center, Neston,
Ma), P.J. Rich, W.J. Burks and M. Gaddy
Thirteen passes of the 53-2 satallite, approxinstaly along the moon-sidulphin meridiae, during
lamsury, 1976 through the region of the dayside
cusp have been studied: eight in the northern
headsphere and five in the southern headsphere.
For all passes the DW B, < 0 and for all but
three passes (F, : 3 - indicating relatively quiet
times. Examination of the east-west component of
the magnetic Hald deflections indicates an extra
current sheet, located polseared of region 1 and
derrying current in the deposite sense, on the
post-mon (pre-noon) side in the northern (southern)
headsphere, but no additional current premon (post-mon) in the northern (southern) headsphere. The component of the convention electric
Liad along the satulties trajectory inorth-scutch
agons that convention reversals coop 2-10 equa-

J. Gaophys. Res., Blue, Paper 1A0189

toward of the boundary between this extra current sheet and the region I field-aligned current sheet. A boundary marking the transition from quasi-trapped to untrapped 100 keV protons was determined. The extra field-aligned current sheet lies almost emittally poleward of this transition boundary suggesting that it may lie in a region of open magnetic field lines. Pine scale structure of the segmetic deflections indicates numerous field-aligned sheet and line currents embedded in the large scale field-aligned current sheets. (Deyside cusp. field-aligned currents, detorts fields).

5530 Vinds and equatorial electrojet HEIGHT AND LATITUDE STRUCTURES OF ELEC-TRIC FIELD AND CURRENT E DUE TO LOCAL EAST-TEST VIEDS IN THE EQUATORIAL ELEC-TROJET O.A. Reddy (Vikram Sarabhai Space Centre, Trivandrum 695022, India) and O.A. Reddy (Vikram Earnomal Space Opetre, Trivandrum 695022, India) and O.Y. Devesia
Using the equivalent electricel circuit method, the height and latitude structures of the electric fields and currents generated by shearing east-west winds have been computed theoretically. The polarisation electric fields, the transverse currents in the magnetic meridically plane and the east-west currents generated by a variety of wind structures are presented to show their height structures and the latitude structures in the geomagnetic latitude range of O to 9°. In addition, the latitude structures of ground-level magnetic field perturbations due to wind-generated currents are also presented. The results are discussed in relation to the observed characteristics of the equatorial electrojst like the day-to-day variability of its latitude structure and observed distortions of the height structure. The implications of the blane dynamics in the equatorial E and F regions are also discussed.

J. Geophys. Res., Blus, Paper 80A1800

5935 Interactions between waves and particles THE EFFECTS OF ELECTRON-NEUTRAL COLLISIONS ON THE INTENSITY OF PLASMA

A. L. Newman (The Assospace Corporation, A6/ 2417, Box 92957, Los Angeles, California, 90009) A17. Her 22957, Los Angeles, California, 20009 and E. S. Oran in the sarch's ionosphere the presence of non-thermal electrons causes anhancement of the electron plasma line resonance observed by incoherent backscatter radar. This paper extends previous calculations of the plasma intensity by including resonance breadening due to electron neutral collisions. A BOK collision term is included to the destroyer of the lectron and the l neutral collisions. A BOK collision term is in-cluded in the derivation of the electron spectral density function obtained from Fluctuation Drasi-pation theory. Assuming the nonthermal electron distribution is a small perturbation on a Max-wellian distribution of background electrons, the expression describing the signal intensity for a plasma line reduces to the form obtained previ-cually when only electron-ion collisions were in-cluded. Results of this attended model are com-aired to recent measurements and early the heared to recent measurements made with the

J. Geophys. Res., Blue, Paper SQA1637

1. Geophys. Res., Blue, Paper SOA1637

1. Geophys. Res., Blue, Paper SOA1637

1. Geophys. Res., Blue, Paper SOA1637

1. All Ico densities and temperatures

ILEVATED RIECTRON TEMPERATURES IN THE AURORAL E

LAYER MEASURED WITH THE CHATANIKA RADAP

1. S. Michary (Div. of Atmospheric Sciences, NSP,

Weshington D.C. 20550) C. Lathulliere, U. Koffman

and G. Laleungs

An excessive series of epectral measurements has

been made in the survoral E region with the Chata
nike lucoberant Scatter Radar. Receive of the

scall scale length for variations of electron den
sity, teoperatures, and ton-neutral collisions we

used the operatures, and ton-neutral collisions we

used the operating mode with the best possible

rage resolution. Blue. About 57, of the time the

data exhibited an unusual spectral shaps that was

cast pronounced at 105 and 110 km. Instead of

two peaks, the spectra are much wider, with two

sell-developed peaks. After carefully considering

two peaks, the spectra are much wider, with two

sell-developed peaks. After carefully considering

two peaks, the spectra are much unusual spectra

see due to strestly enhanced electron temperatures.

At 110 km, the electron temperature may increase

from 250 K to 800 K while the lon temperature re
falis near 250 K. This enhancement of the elec
tron temperature extends from 99 km to at least

11a km. We show that the temperature increase is

too large to be accounted for by survoral particle

pracipitation, though it caincides in time with

ton-temperature extends from 99 km to at least

too large to be accounted for by survoral particle

pracipitation, though it caincides in time with

ton-temperature extends from 90 km to at least

too large to be accounted for by survoral particle

pracipitation, though it caincides in time with

ton-temperature extends from 90 km to at least

too large to be accounted for the particle

so that the electron temperature are a leittudes above

123 km. Decause these latter enhancements are

balleved to be due to 1001 heating, J. Ceophys. Res., Blue, Paper 1A0077

3550 Low-latitude ionospheric currents
MICROWATE EQUATORIAL SCHWILLATION INTERSITY
UNING THE CURBERT SOLAR MAKINEM
J. Asrons(Air Force Geophysics Laboratory,
Ranacos AFE, MA 01731) H. Whitney, E. MacKensie
and S. Basq

Lancos ATP, MA 01731) H. Mittnay, E. Mackinsia and S. Baso
A Constison of scintillation levels at 1.5 GRs needs from the region of the magnetic equator from the region closes to the magnetic equator and from the region closes to the magnetic equator (termed the alectrojet leritudes) showed increased P region during years of high sunspot number. Peak to peak fading greater than 27 dB was noted from Ascension telend (through a dip latitude of 17°) in the anomaly region with only 7-9 dB from Natal, Bravil and Blancayo, Feru were noted, the last two paths close to the magnetic equator. The paths close to the magnetic equator. The paths close to the magnetic equator. The responsible for the fitness gighters scintillation is the traversal of the propagation path through the anomaly region. During years of high sumpor numbers the high levels of dM constituting the P region is trapularity structure are due to (1) Vary high elactron density in region) and (2) the late appearance of these high electron densities to 2200 LT) in the anomaly region. The patches or plumes of irragularities seen in the poak sunses time Parlot then produces high Alm scintillation excursions are proportional to this parameter. In the postaletion of vertical irregularity sheets in the states was armained to deservations transport mainer years of 1959-1970 were reamlysted and sore recent observations from that the states was armained to deservation that from the propagation path rather then just along a path clussely algored with the magnetic servidian, factor, which was the of considerable importance letted in determining the absolute value of the meantime.

Late of the service of the securities of the securities are propagation path or the propagation path or th

Particles and Fields... Magnetosphere

5705 Bow shock waves
A SIATISTICAL SURVEY OF IONS OBSERVED UPSTREAM OF
THE EARTH'S BOW SMOCH: EMERGY SPECTRA, COMPOSITION, AND SPATIAL VARIATION
F. M. Ipavich (Dept. of Physics and Astronomy,
University of Maryland, Collego Part, MD 20742)
A. B. Galvin, G. Glosckler, M. Scholer and D.
Hovastadt

A. D. Galvin, G. Gloschier, M. Scholer and O. Hovestadt

The Characteristics of 33 diffuse particle events in the energy range from ~30 to ~130 keV/O observed upstream of the earth's bow shock have been determined. The neasurements were made with the Ultre Low Energy Charge Analyzer (U.ECA) sensor of the Mar-Planck institut/University of Maryland instrument on 15E-1. The energy spectre of these events are clearly steeper than power law and are generally well described by either an exponential or Maxwellian in energy per charge, with average e-folding values of ~20 keV/O and ~15 keV/O, respectively. The composition in these events is remarkably constant as a function of energy per charge and is similar (within a factor of ~2) to that of the solar wind. The particle flux is found to decay exponentially with distance from the bow shock, with an e-folding distance of ~7 kg for H and We at 30 keV/O. Inverse velocity dispersion was observed in each event, with an average delay time of ~40 min. between the 30 keV and 130 keV proton equilibrium intensity levels. Our measurements are consistent with a Fermi acceleration mechanism and the presence of a free escape goundary upstream of the bow shock. (Upstream particles, Fermi acceleration, composition.)

J. Geophys. Res., Blue, Paper 8041814 Composition.) J. Geophys. Nes., Blue. Paper 8041814

FROM Shock waves

MEASUREMENTS OF BOW SHOCK PARTICLES FAR UPSIREAM
FROM THE EARTH

X. A. Anderson (Physics Department and Space
Science Laboratory, University of California,
Barkeley, CA 94720)
Electrons and ions moving upstream frequently
appear at distances up to 240 Rc from Earth
at times when the direction of the interplanetary
magnetic field allows their propagation from the
bow shock. Strong asymmetries in the ion angular
oftch angle distribution are often observed, a
consequence of the sharp gradient in guiding
center density and very weak scattering. The
gradient is due to the restricted spatial
region over which these particles are accelerated.
The solar wind electric field, E - Vally Bypf
acts on these particles and produces striking
affacts in both the ion angular distrigutions
and the ion energy spectra. and the fon energy spectra.

5705 Now shock waves
CORRELATED WAVE AND PARTICLE OBSERVATIONS UPSTREAM
OF THE EARTH'S NOW SECK
C.C. Enroys (Observations de Paris, 92190 Maudon,
Prance), M.B. Bavessano-Catteneo, M. Dobrowolny,
S. Orsini, A. Mangeney and C.T. Nussell
Data from three 16EE experiments has been analysed during several pariods of turbulence observed
in the soler wind upstream of the Earth's quasiparallel bow shock, Radio observations are used
to walldate a shock model, which is subacquently
used to compute warlous geometrical parassers parairi bow anoch, Manch observations are used to validate a shock model, which is subsequently used to compute various geometrical parassters during all the portods studied. One typical nine hour pariod on 1977 November 4 is distunsed in some detail to illustrate the parassters studied and the correlations found. It is shown that, during this period, the radio noise spectrus has two components, one tentered hear the local electron plasms frequency, and the other at somewhat lower frequencies; the latter component has a shorter wavelength and correlates with the level of m.h.d. torbulence. A multivariate canonical szetistical analysis of particle and m.h.d. data during a two week period shows the the proton anisotropy and turbulence level correlate well with the minimum backstreaming proton parallel valocity Pagin which, as defined here, is a purely geometrical paraseter. Trivariate analysis shows that the correlation of particles and turbulence with the angle between the sagnetic field and the shock normal have their sense raveread when allowance le made for the strong carrelations with Pagin. A very good correlation has been with Pain. A very good correlation has been found between power and compressibility in magnetic fluctuations. (for shock, turbulence).
J. Geophys. Res., Blue, Payer 180158

DOMEE LAYERS AND ELECTROSTATIC SROCKS
Hoad Hershkowits (Department of Astro-Geophysics,
University of Colorsdo, Boulder, Colorsdo 80309)
It is shown that it is useful to define double
layers and shocks so that the ion phase spaces of
double layers are shown to be just the mirror
image (about zero ion velocity) of the ion phase
spaces for Laminar electrostatic shocks. The
distinguishing feature is the direction of the
free ion velocity. It is also shown that double
layers can exist without the presence of trapped
fone. The Bohm condition for double layers,
that the ion drift velocity on the high potential
side must be greater than the ion sound velocity,
is shown to be related to a requirement of a
lover light on the Mach number of imminer
slactrostatic shocks. (double layers, slectrostatic shocks) static shocks)
J. Geophys, Bes., Nime, Paper 140172

5720 Interactions between solar vied and mag-DECORPHOES AND PARTICLES: AN OVERVIEW OF Project of the Control of

Rootigues
This issue contains results presented at the Upstream Wave and Particle Workshop held at the Jac Propulsion Laboratory, California Institute of Technology, Passdens, California on 15-16 April, 1980. This overview article rizes the results of the collective ISEE remaining to be solved are mentioned with the hope that readers may be sufficiently aroused to attempt to studyloue them. In conclusion, some obvious astrophysical implications are discussed. J. Geophys. Rec., Blue, Paper 140188

DISAPPEARING SOLAR FILAMENTS: A USEFUL PREDICTOR OF BEOMARETIC ACTIVITY
J. A. Joselyn (National Oceanic & Atmospheric Administration, Environmental Research Laboratories, Space Environment Laboratory, Boulder, Colorado BOSOJ) P. S. Atlintosh
Disappearing solar filaments have long been suspected as an indicator of terrestrial megnetic disturbences. However, because filament disappearances are a combon solar event and because they failed as a candidate source for M-region (recurrent) magnetic disturbences, their potential utility as a forecasting aid for geomegnetic storms has largely been negleted. A search for possible solar sources of geomagnetic storms from June 1976 through June 1979 has revealed that a significant number of the storms, including the two largest, can only be associated with filament disappearances. This result is supported by the many recent papers studying SKMAB and other observations of coronal translants which always find a strong correlation between those translants and arguitum prominences. By enalyzing the physical characteristics of those disappearances, which precede magnetic storms and those which do not, some tentative guidelines for forecasting decompanies and tentative guidelines for forecasting decompanies and coronal magnetic field which could release solar wind plasma favorably positioned to impdet the earth.
J. Geophye. Rea., Blue, Paper 140199

garth. J. Geoghys. Rec., Blue, Paper 110199

5730 Placan colion, convertion, or rivolation GROUND-BASED OBSERVATIONS OF THE 10 TORNS DUBING WONAGER I EXCOUNTER: INHICATIONS OF ENHANCED PLASM, INHICATION AND IPANSPORT A. Eviator Department of Arromphuric Sciences, University of California, los Ampeles, CA 90024 b Y. Mekler, N. Brosch and T. Kizah Ground-based spectroscopic observations of the cold to torus made before, during and after the Voyager i encounter are copared to the published spectraft data. During the encounteritable in either sodium nor sulfur emissions when detected. The implications of this finding for the injection and transport of places are assessed. (To torus, Voyager encounter, optical spectrosropy). optical spectroscopy). Geophys. Res. Lett., Paper II.Ollb

S740 Plasma motion, convection or circulation PRODUCTION AND TRANSPORT OF 0° 1N THE 1000-EFHERR AND TLASMASPHERE J. Gaiss and D.T. Young thysikalisches Institut, University of Bern, 1012 Bern, Switzerland) The abundance of 0° 0° 40° has been observed to reach values of unity and above in the aquatorial plasmasphere at L-J. This is two to three orders of magnitude greater than the relative 0° shundance at corresponding latitudes in the topside immosphere. In this paper we pursue our earlier suggestion that thermal diffusion 0° 0°, driven by the temperature gradient between the ionosphere and equatorial plasmasphere, is responsible. We have carried out this study by newarically integrating the time dependent diffusion equation for equipox conditions. Recent plasmaspheric data from the 6003-1 spaceraft have been incorporated (into a realistic model of the temperature and densities of major ion species extending from the ionosphere to the equatorial plane. Convection as well as local time variations and details of iou chemistry have been lucluded in the model.

tions and details of tou chemistry have been lucluded in the model.

Our main conclusion is that only theresi diffusion can account for observations of 0"/0" of the equatorial planatasphere, Furthermora, we have found that there is a threshold temperature gradiont between ionosphore and equatorial planatasphere, corresponding to an equatorial temperature at L=3 of 2.5000 K, below which thereal diffusion becomes innerestimates.

5760 Plasma motion, convection, or circulation 1 OW-ENERGY EON PITCH-ANGLE DISTRIBUT-TIONS IN THE OUTER MAGNETOSPHERE' ION AIPPER DISTRIBUTIONS ION AIPPER DISTRIBUTIONS
J. F. Fennell, B. R. Croley, Ir. (both at:
Space Sciences I aboratory, The Accorpace
Corporation, P. O. Rev 2257, Los Angeles,
CA 20009 and S. M. Kaye
lon pitch-angle distributions, measured in a CA '00009) and S. M. Kaye

To pitch-angle distributions, measured in a near synchronous orbit, are pre-to-minantly field-aligned at low energies and pre-to-minantly peaked perpositionle to the magnetic field at higher energies. The transition from field-aligned fluxes to thomas peaked pre-dominantly perpositionar to the magnetic field occurs over a vory narros energy range. These conditatibutions have been observed at all local times between 5.4 E, and 7.8 E. This transition energy correlates with the deep minimum released in the lon spectra. There is no apportent correlation between the not transition energy and magnetic local time, L. Ep, or list. However, the transition energy does respond to observed particle injections. The transition energy decreases prior to Injection, increases already at injection by as much as 10 to 20 FeV and then decrease in latensity over several hours to instrument threshold level. Ion drift trajectory calculations indicate that the low-energy component below the transition energy drifts in from the day not. The captures on the day not. The captures on the day side values content, arrows on the day not. The captures on the day side values content, arrows on the day side values. Blue, Paper L0012.

5770 Short period (less than I day) variations of magnetic field CAMRGED PARTICLE BEHAVIOR (N LOW FREQUENCY GEOMAGNETIC PUSATIONS: 1. TRANSVERSE WAYES B. J. Southwood (Department of Earth and Space Sciences, University of California, Los Angeles, Los Angeles, Los Angeles, Cas Spacecraft-borne detector would observe. We concentrate on the affects of purely transverse electrocagnetic rignals. The time scale of a particle's motion relative to the wave period is shown to determine the mature of its response. For low energy particles, the acceleration is that matters. At higher energies, what has occurred over recent bowness and drift motions becomes increasingly important and convection of gradients by the wave E x B drift must be considered. Distinguishing features such as phase differences between signals in bact-to-bact datectors or between channels of different energy are catalogued. In particular, we assess the detectability of resonante affacts in the light of detector characteristics and finite signal bandwidth. Recent observations are used to illustrate the ideas developed.

7/70 Short-periud (less than 1 day) variations of magnetic field
DISTRIBUTION OF AMPLITUDES OF GEOMAGNETIC VARIATIONS AND BELATIONSHIPS TO THE K INDEX
M. Kone (Bell Laboratories, Martey Mill, R.J.
07974), L. J. Lencerotti and C. G. Maclensan
We study in this brief report the properties
of amplifical cumulative distribution functions
of geomagnetic signals measured at three hoor of geomagnetic signals measured at three hour intervals for one separate one-month periods at three stations spaced in latitude from 1-3.2 to L-8.0. The completive distributions are also compared to theoratical constitute distribution. The widths and amplitudes of the amplifical distributions, an wall as thair deviations from Gaussian, are studied and compared to the global and "local" (in longitude) geomagnetic K-foddcas. In general, the widths of the empirical distributions hecome breader with increasing geomagnetic activity; the widths of the distributions are narrower at lower latitudes for a given level asgentic activity. Hany sepirical camplative distribution fractions compared for the increasing geomagnetic activity. Hany sepirical camplative distribution fractions deviations show no relative to magnetic estivity. (Regametic indicious) J. Geophys. Res., Slue, Paper 1A0097

1750 Wave propagation
THE RFFEOT OF MICROSCOPIC TURBULENCE OF
MACHITOSPHERAL-IOMOFINER CONFILED
R. L. Lysak and C. V. Carison (Space Sciences
Laboratory, Onlywinity of California, Serkalay,
CA 94720)
The affect of turbulence on the coupling of the
appartments and (consobers has been livesti-

semestophers and ionosphers has been investi-pated by including an effective cullinion frequency in the electron equation of nation. When this term is combined with the continuity unen this term is commined whit the continuaty equation, the son equation of motion and harvell's equations, a dispersion relation for the kinetic Airve wave including affective collisions is found. The stre-particle lightraction leads to a strong damping of the wave. Including of the street of plane wheat binatics which is not a strong to plane wheat binatics which is not a strong to plane wheat binatics which is not a strong to plane wheat binatics surorel arcs. Geophys. Res. Lett., Paper 11.0137

Planetology

6510 Atmospheres of Flanets SPECIFICOCOPY OF THE CAMERON BANKS IN THE MAKE

6510 Atmospheres of Flamets
SPRINGOGEY OF THE CARREST ENTIRE IN THE MAC.
ATRILION
B. R. Gormay (LACP, Univ. of Cv., Campus No. 392,
Boulder, CO 80309)

Fars singlew spectra acquired by the ultraviolet spectromator experiment of Fartner 9 serve
analyzed by using a high resolution synthesis.
The carbon monoride Cameron bands are the
brightest features between 1800 and 2600 A in the
observation of altitudes between 80 and 180 km.
The shape of these bands cannot be charecterized
by any single rotational temporature but is beat
described by temporatures of 1600 K for hour J
values and 10,000 K for higher J values. The
first negative bands of CV are not identified
in the residual spectra. The observed zenith
intensity of the Cameron bands is 16.7 kM and is
in good agreement with a theory with electroninquot dissociation as the nost important excitation sectantes. The observations suggest the
value of the crosp section for this process
should be 7 x 10-17 cm².
J. Geoghya, Res., Blue, Paper 140016

6310 Attoopheres of planets
103 TEMPERATURE ANILOTPOPY AND HEAT FLOW IN THE
VERUS LOWER TOMOSPHERE.
R.W. Schunk (Center for Attoumpheric and Space
Scionces, Utah State University, Logan, Ulah
84312) and I.-P. St.-Neurice
Rottvated by the recent wheervations of supersonic ion flow in the Verus Londsphere near the
caminator, we have studied the outent to which
such a flow can induce as lon temperature aniactrapy and a diffusion-thermal heat flow. Dur
calculations indicate that appreciable ion
teoperature solventypies can be induced at attitudos below about 220 ha. The respectative
anisotropy is with respect to the ion-cautral
foliative drift valocity vector, with the ion
teoperature which is a relative drift
volucity greater than the perpendicular ion
teoperature. The parallel to the rolative drift
volucity greater than the perpendicular ion
teoperature. The parallel to perpendicular ion
teoperature. The parallel to be in the range
of free 2-4, depending on the ion-mosphoric conditions. We have also found that in the same
lonesphoric region the ion-mostral relative
drift induces a diffusion-thermal heat flow
that the considerably rate important than ordithat is considerably note important thea ordi-nary too therail conduction. Consequently, diffusion-therail heat they could have an ap-preciable effect on the ion energy balance in the "coust lower tempopare. J. G.ophys. Ron., Blue, Paper 140211

Offir Atmospheres of planets

Ny ABUNDART IN THE ATMOSPHERE OF VENUS

No Furnary, D.M. Kunton Clumar and Planetary Laboratory, University of Artsona, Tucada, Artsona Sy/215 M.A. Taylor, Jr.

The In alta metaurocomia from the Pioneer Venus orbiter (Pro) 10m Mans Spectrometer have led to the detrection of My 1 inns in the Venus Sommablers. Although My 1 is a short for, the measurement provides the litest direct clue for determining the My abundance in the upper area-aphore of Youne. A Protect-online that wing Proceedings of the Province is used to Jetley in My blaing ratio file ppr felow 130 to altitude. The presence of this ratch My confitten our previous prediction that the tractions of Off with My and subsequent recentionston of Off provide as Ingerest source of meathermal M observed in the Venus examphers. The excitated manage first for the in 100 cm 2 s 1.

(Venus, serno-my, tonospheres)

osid Atmosphere of planets
AUPORA IN SUPTIEP'S AIPOSPHERE'
A.F. took if, A. Valiages Jones and
D.E. Sheamashy (Harth and Space Sciences
Institute, University of Southern
California, Jucoun Laboratories, Turana,
AZ B571)
The darkside limb pictures obtained by
the institute armeriment on Vayages I been

the imaging experiment on Voyager I have been resembled. It is concluded that the observed luminosity is very likely due at least in part to lo torus aurora. If the effective wavelength of the existing lies in the 4000 χ to 5000 χ region, the be due to a number of causes such as horizontal structure in suroral emission surora plus twilight or photochemical singlew plus surora. (aurora_Jupiter, imaging). J. Geophys. Res., Blue, Paper 1870/1

ORIGIN OF MARTIAN OUTFLOW CHANNELS: THE ECLIAN SYMOTHESIS

J.A. Cutts (Planetary Science Institute, Science Applications, Inc., 28) S. Lake Ava., Suits 218 Pasadens, CA 91101) K.R. Blastus

The sacient outflow channels on Mars exhibit fossil flow patterns similar to current flow patterns in terrestrial desert regions crodel by wind. We have modelled outflow channel formation by a cascade process in which sand-sized particles produced by rock weathering in the chaotic terrain "source areas" of the outflow channels were transported by the wind across the adjacent plateau surfaces and bleating end deflating the surface. Comparisons of model predictions with photogeologic data susquest that rates of rock breakdown by physical and chanical action along the channels during the channel forming ers must have been much higher than they have been on similar terrains formed after the channel ora ended. A tenuous atmosphero, comparable to the promet one, could have transported materials sufficiently rapidly to excavate outflow channels in about 10 years. Nowever, there may be difficulties in explaining how shrading particles could survive high velocity impedes in a thin atmosphere channels in about 106 years. However, there may be difficulties in explaining how abrading particles could survive high velocity impacts in a thin aimosphere over the semy hundreds or even thousands of kilometers that they were transported in outflow channels. It is difficult to avoid the conclusion that a climate change affecting rock breakdown rates, atmospheric density, or both occurred early in martian history to end the era of outflow channel formation. Particulate materials generated during this era may be important components of the necth circumpolar dune field and the polar layered doposits.
[Mars., channels., erosion, climate, wind).
J. Geephys. Rea., Red., Paper 180021

6375 Surface of Planets ON THE GALILEAN CHORDWARES OF FRATURES ON THE GALILEAN SATELLITES
N. E. Davies (The Rand Corporation, Santa Homica, California 90406) and F. Y. Katayama actulities cours in the Course of the Galilean satulities have been satablished photogrammatically from platures taken by the two Yoyager spaceraft during their figures of longer in 1979. Consellpictures taken by the two Yoyager spacecraft during their Thybys of Jupiter in 1979. Goordinates of 504 points on Io, 112 points on Europe, 1547 rotate on Ganymede, and 439 points on Callisto are listed, Selected points are identified on USCS maps of the satellites. Measurements of these points were made on 234 pictures of England and 200 pictures of Europe, 282 pictures of England 200 pictures of Calliste. The systems of Jungitude were defined by craters on Europe, Compande, and Callisto, Freshintary solutions have been found for the directions of the arms of rotation of the Callisto setellites. For mean radii have been datermined as 1815 ± 3 th for IO, 156 ± 10 the for Europe, 1611 ± 10 the for Ganymede, and 2500 ± 10 tm for Callisto, (Galiston Estellites, coordinate features).

J. Grophys. Res., Red, Paper Schiffs